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FROM

THE SECRETARY TO THE GENERAL COMMITTEE
OF THE G. V. JUGGAROW OBSERVATORY, VIZAGAPATAM.

To

THE SECRETARY
TO THE GOVERNMENT OF MADRAS,
MADRAS.

Dated SIMLA, *the 5th October*, 1898.

SIR,

I have the honor to submit the following Annual Report on the condition and progress of the G. V. Juggarow Observatory at Vizagapatam during the year 1897, for the information of the Government of Madras and for transmission to the Government of India.

The third annual meeting of the General Committee.

The Third Annual Meeting of the General Committee of the G. V. Juggarow Observatory was held on Friday, the 15th April, 1898, at 5-30 P. M.

The members present were :—

W. O. Horne, Esq., C.S., *Chairman.*
F. E. Sicé, Esq.
J. Eliot, Esq., M.A., F.R.S., C.I.E., *Secretary.*

The members of the Committee inspected the observatory, and found it in satisfactory condition and instruments all in good order; and were greatly satisfied with the progress made during the year.

The minutes of the last meeting were read and confirmed.

The statement of accounts for the year 1897 was examined and passed.

The Astronomer's report on the working of the observatory for the year 1897 was taken as read and ordered to be published in the Administration Report.

Read a letter from the Astronomer stating that the period of three years for which he had been appointed had expired, and asking for an increase of pay.

Order:—The Committee recognize the excellent work done by Mr. Bion and sanction an increase of pay from Rs. 350 to Rs. 400, with effect from 1st May.

The Secretary stated that as the telegraph line to the time gun was completed and would shortly be used in signalling the time to the gunner, the present arrangement of paying him a monthly pay of Rs. 5 and a reward of Re. 1 on every occasion the gun was correct should be discontinued. He suggested a monthly payment of Rs. 12 with the understanding that a fine of annas 8 would be levied whenever the error of the gun amounted to as much as 5 seconds.

Order:—Proposed arrangement approved.

The estimate of receipts and expenditure for the year 1898 was drawn up and passed.

The Secretary was asked to prepare the Administration Report for 1897, as in previous years.

Read notification by the Government of India, R. and A. Department, dated 2nd April, 1898, altering the rules for the management of the observatory, for the purpose of providing for the appointment of additional members of the Committee if found necessary.

The General Committee authorize the Secretary to write to the Government of India and propose the addition of two local members, *viz.*,

The Port-officer for the time being;

The Superintendent of Telegraphs for the time being.

Condition of the Meteorological Department.

The work of the Observatory has been carried on as usual during the past year, but it was much interrupted by sickness among the staff. Mr. J. Nimmock, the writer who keeps some of the registers and helps in reducing observations, was ill for half the year. The head observer was absent for about a month and a half on the same pretext, and at the end of November had to be dismissed, because he again absented himself, and on this occasion without leave. The fourth observer was also ill for about a month.

There was hence some difficulty in keeping current work up to date, more especially as the work has increased considerably this year by the establishment of the new observatory at Waltair, and the reduction and tabulation of hourly observations from the traces of the self-recording meteorological instruments which have now been brought into use.

The buildings are all in good order. A small house for the man in charge has been built at the Waltair Observatory. The thanks of the Committee are due to Mr. A. Morton, the Locomotive Superintendent, East Coast Railway, for assistance he kindly gave in the erection of the Anemograph.

As already explained the observers had harder work than usual both on account of an increase in the work itself, and also because of constant absences in their number, due to sickness. But, with the exception of the head observer, whose conduct was not always quite satisfactory, the observers all worked cheerfully and well and the reduction and tabulation of observations have been kept well up to date.

Extracts from Mr. Bion's report on the work of the Astronomical Department of the Observatory in 1897.

In the *Astronomical Department* work has been confined to the measurement of double stars, photography, and the daily time service. The equatorial driving clock had to be sent twice to Madras for repairs early in the year and it was not received back in proper working order till September. Hence no micrometer measurements could be taken till the end of the year, but during the last three months a large number of double star observations were made, the stars selected being with one exception from the list of suspected binary stars given in Chamber's "Astronomy." The following were the stars selected:

	R. A.	Decl.
41. Aquarii	22 8 14	−21 37·3
μ Cygni	21 39 42	+28 18
γ Arietis	1 47 29	+18 45·3
γ Ceti	2 37 36	+ 2 48
326 Σ Arietis	2 49 6	+26 26

Photographs of various clusters and nebulæ were taken with the small photographic telescope, the best being perhaps that of the region near η Argus. As the lens of the camera is a small one photographs of nebulæ are not as successful as those of clusters. Professor H. H. Turner, Secretary of the Royal Astronomical Society, very kindly helped me in this branch of my work by advice as to the best kinds of plates to use. I sent to London for a selection of various kinds which I am now testing.

The work of the time service has been carried on as usual, the error of the sidereal clock being determined by transits of clock stars, and the flash of the time gun and its error being observed every night from the observatory. A telegraph line has been constructed with the object of giving the signal to the gunner by an electric bell, but though the observatory end of the line has been fitted up, there has been much delay in obtaining sanction from the Military Department in Madras for the erection of a suitable shed near the gun, and thus the line has not yet been used though it was completed and made over to the observatory on 21st August.

Extract from Mr. Bion's report on the work of the Meteorological Department of the Observatory in 1897.

Meteorological Department.—Observations of the double set of instruments for comparison between the old and new exposures were continued during the year, but were discontinued from 1st January, 1898. A statement showing the differences for ten day periods of each month, and for each of the five hours of observation, has been prepared and is utilised in comparing observations with the normals of the 26 years ending 31st December, 1895.

The Waltair Observatory has been fitted up with instruments and is now in working order. The following instruments have been lent for use at that observatory by the Government of India :—

Beckley's self-recording anemograph.

Dines's pressure tube anemometer.

A set of thermometers, consisting of dry and wet bulb, maximum and dry and wet minimum thermometers.

Readings of Dines's anemometer and of the thermometers are taken daily at 8 A.M. With the help of the anemograph and Richard's self-recording barograph and thermograph a complete series of hourly observations of wind, pressure, temperature and humidity is being secured and tabulated in a register kept for the purpose. The barograph and thermograph traces are compared with the eye observations of the mercurial instruments five times a day, and the monthly means have the necessary corrections applied to them as determined by these comparative readings.

Daily weather telegrams have as usual been despatched to the Meteorological Reporters to the Governments of India, Bengal and Madras, and meteorological returns supplied to the Meteorological Department, Government of India, and to the Port Officer, Vizagapatam. Special storm observations were supplied to the Meteorological Reporter to the Government of Bengal on four occasions during the year, *viz.*, 1st to 2nd October, 17th October, 22nd to 24th November, and 27th December.

Special thunderstorm observations were also taken during the year according to forms supplied by the Meteorological Department. The classification of clouds was changed from 1st June, in accordance with instructions received from the Meteorological Reporter to the Government of India, the classification and system of observation adopted being that given in the International Cloud Atlas.

I have been engaged in preparing a paper on the rainfall of Vizagapatam based on the old records of the observatory (the first of an intended series on the meteorology of Vizagapatam) which is now in the press. The raingauge formerly in use was found to be incorrect and a correction had to be applied to all the old rainfall records, which has caused a delay in the completion of the paper.

Miscellaneous.—The Library has received a good deal of attention, and 486 volumes or parts of volumes have been added during the year. Its usefulness has been greatly increased by the generous help of the following Societies, &c., who have promised to present their publications to the Observatory.

Royal Astronomical Society.
Royal Geographical Society.
Royal Society of Victoria.
Weather Bureau, U. S. America.
U. S. Naval Observatory.
John Hopkins University, Baltimore, U.S.A.
Meteorological Service, Dominion of Canada.
Asiatic Society of Bengal, Calcutta.
Meteorological Commission, Cape Town.

The Royal Astronomical Society and the Royal Society of Victoria have been especially kind in supplying back volumes. The Observatory now possesses an almost complete set of the Royal Astronomical Society's valuable publications. Deficiencies in the set of the Government of India meteorological publications have also been filled up as far as possible by the kindness of the Meteorological Reporter to the Government of India, and very few volumes are now missing in this series of publications.

The comptometer has arrived and has proved of great service in computations of various kinds. A sidereal-time watch has been ordered for use in the photographic observatory. The camera and chronometer, the purchase of which was sanctioned by the Committee at their last meeting, were kindly ordered for the Observatory by Mr. C. Michie Smith, Government Astronomer, Madras, but they had not arrived by the end of the year.

Accounts.

A full statement of the accounts of the Observatory during the past year from 1st January to the 31st December, 1897, will be found in Appendix I.

The following gives a summary of the income and actual expenditure during the year:—

RECEIPTS.

	Rs.	As.	P.
Balance from 1896	2,927	9	7
Interest on Endowment	10,473	12	0
Total ...	13,401	5	7

EXPENDITURE.

Ordinary.

	Rs.	As.	P.
Establishment	7,029	12	4
Repairs	427	10	5
Time Service	441	11	6
Contingencies	504	12	8
Photography	91	3	4
Library	227	9	2
Municipal Taxes	31	4	0

Extraordinary.

Waltair Observatory	164	10	6
New Instruments	572	14	0
Total Expenditure ...	9,491	7	11
Balance ...	3,909	13	8
Total ...	13,401	5	7

The sanctioned estimate for expenditure for the year was Rs. 10,733 which included a grant of Rs. 1,350 for the purchase of new instruments. The actual expenditure was Rs. 9,491–7–11 or Rs. 1,241–8–1 less than the sanctioned estimate, chiefly due to a saving of Rs. 777–2–0 in the purchase of new instruments and of about Rs. 200 in establishment, and of about Rs. 200 under the head of printing. The balance which at the beginning of the year was Rs. 2,927–9–7 was hence increased to Rs. 3,909–13–8 at the end of the year.

Estimate of Income and Expenditure for the year 1898.

INCOME.				ESTIMATED EXPENDITURE.					
	Rs.	A.	P.	*Ordinary.*	Rs.	A.	P.	Rs.	A. P.
Balance on 31st December, 1897 ...	3,909	13	8	Astronomer's Salary	4,800	0	0		
Estimated Income during 1898 ...	10,473	12	0	House Rent	600	0	0		
				Establishment (including Waltair) ...	2,454	0	0		
				Time Service	500	0	0		
				Photography	100	0	0		
				Printing Report for 1897	150	0	0		
				Repairs to Buildings and Fittings ...	400	0	0		
				Postage, Office charges and Contingencies	400	0	0		
				Library	200	0	0		
				Taxes	138	0	0		
								9,742	0 0
				Extraordinary.					
				Reward to gunner for correct guns during 1897 (system of payment to be changed from this year) ...	88	0	0		
				Printing Report for 1896 ...	97	14	0		
				New Instruments	800	0	0		
				Travelling expenses for Solar Eclipse	345	14	10		
				Printing papers on Meteorology of Vizagapatam	200	0	0		
				Library	50	0	0		
								1,581	12 10
								11,323	12 10
				Balance ...	.....			3,059	12 10
Total Rupees ...	14,383	9	8	Total Rupees ...	.....			14,383	9 8

A further sum of Rs. 5,075 falls due on 31st December, 1898, which increases balance at end of year to Rs. 8,134-12-10.

JOHN ELIOT. W. O. HORNE. F. E. SICÉ.

APPEN

Abstract Cash Account

RECEIPTS.

			Rs. As. P.	Rs. As. P.
Balance	.. ..	.....		809 0 11
	Vizagapatam Treasury Account.			
January,	1897	200 0 0		
February	„	600 0 0		
March	„	800 0 0		
April	„	800 0 0		
May	„	1,000 0 0		
June	„	600 0 0		
July	„	700 0 0		
August	„	600 0 0		
September	„	844 1 0		
October	„	900 0 0		
November	„	600 0 0		
December	„	1,000 0 0		
				8,644 1 0
	Elliot Stock's Account.			
January,	1897	7 2 6		
March	„	15 13 10		
April	„	20 7 7		
May	„	14 11 8		
June	„	25 11 5		
July	„	2 12 3		
August	„	59 7 4		
September	„	1 4 5		
November	„	13 7 9		
December	„	48 0 4		
				208 15 1
	Interest on Endowment Account.			
August,	1897	.....		10,473 12 0
	Repairs Account.			
August,	1897	.....		31 12 0
				20,167 9 0

DIX I.

for the year 1897.

EXPENDITURE.

		Rs. As. P.	Rs. As. P
Establishment Account.			
January, 1897		581 10 5	
February „		579 13 4	
March „		619 13 2	
April „		606 14 10	
May „		609 7 10	
June „		608 9 6	
July „		609 7 10	
August „		608 0 0	
September „		557 15 0	
October „		558 0 3	
November „		553 10 4	
December „		536 5 10	
			7,029 12 4
Repairs Account.			
January, 1897		55 0 3	
February „		31 4 0	
March „		36 15 9	
April „		76 0 3	
May „		54 2 4	
June „		18 7 3	
July „		27 10 4	
August „		8 1 6	
September „		35 3 8	
October „		79 1 9	
November „		23 2 4	
December „		14 5 0	
			459 6 5
Time Service Account.			
January, 1897		84 0 0	
February „		3 5 0	
March „		6 0 6	
June „		0 9 0	
August „		6 11 0	
September „		257 8 0	
October „		80 9 0	
November „		3 6 0	
			441 11 6
	Carried over ...		7,930 14 3

RECEIPTS.

		Rs. As. P.	Rs. As. P.
Brought over	...	.....	20,167 9 0

Carried over	...	... ...	20,167 9 0

Expenditure.

			Rs. As. P.	Rs. As. P.
		Brought over		7,930 14 3
	Waltair Observatory Account.			
January,	1897		11 13 6	
March	„		93 8 4	
April	„		3 6 3	
May	„		55 14 5	
				164 10 6
	Contingencies Account.			
January,	1897		32 7 10	
February	„		11 12 5	
March	„		64 1 10	
April	„		22 15 8	
May	„		79 14 3	
June	„		29 6 3	
July	„		17 2 6	
August	„		14 14 2	
September	„		44 0 4	
October	„		43 13 11	
November	„		52 0 5	
December	„		92 3 1	
				504 12 8
	Photography Account.			
January,	1897		1 7 0	
April	„		4 4 0	
May	„		7 1 0	
August	„		41 10 5	
September	„		5 0 2	
November	„		14 1 9	
December	„		17 11 0	
				91 3 4
	New Instruments Account.			
January,	1897		9 10 9	
February	„		59 0 0	
March	„		18 4 0	
May	„		32 6 0	
November	„		39 14 0	
December	„		413 11 3	
				572 14 0
	Library Account.			
January,	1897		13 2 6	
February	„		13 9 0	
March	„		29 8 10	
April	„		22 7 7	
May	„		14 7 8	
		Carried over ...	93 3 7	9,264 6 9

Receipts.

	Rs. As. P.	Rs. As. P.
Brought over		20,167 9 0
Total Rs.		20,167 9 0

Expenditure during 1897.

stablishment		7,029 12 4
Repairs		427 10 5
Time service...		441 11 6
Waltair Observatory		164 10 6
Contingencies		504 12 8
Photography		91 3 4
New Instruments		572 14 0
Library		227 9 2
Municipal Taxes		31 4 0
Total Rupees		9,491 7 11

Expenditure.

					Rs.	As.	P.	Rs.	As.	P.
			Brought over	...	93	3	7	9,264	6	9
June	1897	...	...	...	33	3	5			
July	„	...	...	...	2	12	3			
August	„	...	...	...	17	5	2			
September	„	...	...	...	1	4	5			
October	„	...	...	...	24	7	0			
December	„	...	...	...	55	5	4			
								227	9	2
	Municipal Taxes.									
January,	1897	...	...	...	.....			31	4	0
	Vizagapatam Treasury.									
August,	1897	...	...	...	.....			10,473	12	0
								19,996	15	11
			Balance	...	.....			170	9	1
			Total Rupees	...	.....			20,167	9	0

Balance Sheet.

	Rs.	As.	P.		Rs.	As.	P.
Expenditure during 1897	9,491	7	11	Balance from 1896 ...	2,927	9	7
Vizagapatam Treasury	3,677	15	9	Interest on Endowment	10,473	12	0
Elliot Stock ...	61	4	10				
Cash in hand ...	170	9	1				
Total Rupees ...	13,401	5	7	Total Rupees ...	13,401	5	7

W. O. Horne.
F. E. Sicé.
John Eliot.

APPENDIX II.

Meteorological Observations.

No change has been made in the hours of observation, which continue to be 4, 8, 10, 16 and 22 hours, mean civil time.

Readings of the thermometers in Rani Ankitham Atchayyama's drawing-room were continued during the year but were discontinued from the 1st January, 1898.

The following is a list of meteorological instruments in use during the year at the observatory in Vizagapatam.

Name of Instrument.	No. of Instrument.	Maker.	Remarks.
Fortin's barometer ...	1684	L. Casella	Up to 30th June.
Do.	1855	Do.	From 1st July.
Dry-bulb hygrometer ...	91702	Do.	
Wet bulb „	91703	Do.	
Dry minimum thermometer ...	91303	Do.	
Wet „ „ ...	80693	Negretti and Zambra.	
Maximum „ ...	78284	Do.	
Sun maximum „ ...	7882	Do.	
Grass minimum „ ...	38481	L. Casella.	
Rain-gauge	531	Do.	
Sun-shine recorder ...	...	R. J. Lecky.	
Richard Frère's single-day barograph	...	L. Casella.	From 1st February.
Richard Frère's single-day thermograph (dry and wet)	...	Do.	From 1st February.
Robinson's anemometer ...	...	...	

The following are the instruments in use at the Waltair Observatory.

Name of Instrument.	No. of Instrument.	Maker.	Remarks.
Dry bulb hygrometer ...	100674	L. Casella.	From 1st Feb.
Wet bulb „ ...	100684	Do.	
Dry minimum thermometer ...	83123	Negretti & Zambra.	
Wet „ „ ...	83125	Do.	
Maximum „ ...	80553	Do.	
Beckley's anemograph		L. Casella.	From 1st April.
Dines's pressure tube anemometer		R. W. Munro.	From 1st July.

Several changes were introduced during the year, one of the most important of which was the establishment of the subsidiary observatory at Waltair where observations have been taken from the 1st February.

Another innovation has been the introduction of self-recording instruments for pressure, temperature and wind, by means of which a valuable continuous record of these elements is being obtained which will doubtless throw much light on the climate and meteorological conditions of Vizagapatam.

Excessive temperatures and unusually scanty rainfall were the chief features of the greater part of the year 1897. The year opened with abnormal conditions, the immediate consequence of the complete failure of the north-east monsoon in 1896. In January and February the temperatures recorded were in large excess of the normal, the excess being greatest at night; skies were more heavily clouded than usual and there was a large excess of vapour pressure which amounted to over a tenth of an inch in February. These abnormal conditions were not so strongly pronounced in the following months.

During the hot weather of 1897 there was an unusual number of thunder-storms and the rainfall due to this class of atmospheric disturbances was thus above the average, the excess being largest in May; but this was followed by very dry weather in June, when instead of the usual monsoon rainfall of 3·51 inches only 0·87 inch was received. The effects of this failure of the monsoon rains were most

disastrous on the early crops, and as the unseasonable deficiency in rainfall continued during July and August agricultural prospects did not improve. Consequent on the failure of rainfall temperature continued unusually high till September, when happily there was a marked change for the better. Rainfall increased considerably and, though October again was a drier month than usual, the percentage of defect was not so great as in the early part of the monsoon, and in November there was more rain than usual; this being the first and only month of the monsoon in which rainfall was in excess of the normal.

Temperature conditions were fairly normal in December. The most remarkable feature in this month was the unusual dryness of the air, both relatively and absolutely. Relative humidity was 8 per cent. less than usual and vapour pressure 0·077 inch below the normal.

Pressure was practically normal in January, May, July, August and December, in defect in February, March, June, October and November and in excess only in April and September. It varied from the normal most in February when it was 0·059″ in defect. The next largest variation occurred in April and September, the two months of excessive pressure, in both of which pressure was 0·036 above the normal. With the exception of these three months and October (when it was 0·031 in defect) the variations from the normal were not large. In the months of defective pressure the largest variation from the normal was shewn chiefly in the observations taken at 10 A.M.

The following table gives the highest and lowest pressures (reduced for 32°) recorded each month with the dates and hours of their occurrence.

Month.	Highest Reading.	Date.	Hour of Occurrence.	Lowest Reading.	Date.	Hour of Occurrence.
January	30·148	22nd	10	29·834	29th	16
February	30·034	7th	9 & 10¾	29·736	26th	16
		8th	10			
March	30·023	9th	10	29·720	23rd	15½
April	29·936	15th	9 & 10	29·670	30th	16¾
May	29·820	1st	9	29·529	7th	16

Month.	Highest Reading.	Date.	Hour of Occurrence.	Lowest Reading.	Date.	Hour of Occurrence.
June	29·740	1st	9	29·330	16th	16½
		6th	8 & 9			
		10th	8½			
July	29·715	22nd	9	29·430	9th	16¼
August	29·820	20th	22½	29·410	8th	16¼
September . .	29·890	25th	9½	29·485	9th	16¾
		26th	8½			
October	30·034	27th	9 & 10	29·440	2nd	14½
November ...	30·040	18th	9	29·760	11th	15
December ...	30·180	6th	9¼	29·815	27th	15

The highest pressure during the year was 30·180″ recorded at 9–15 A.M., on 6th December, and the lowest 29·330″ at 4–30 P.M., on the 16th June. The extreme annual range of pressure was hence 0·818″ which was 0·079″ less than in 1896.

Some remarkable oscillations of pressure will be found noticed in the thunderstorm observations.

Temperature. The temperatures registered during 1897 were very abnormal. During only two months, those of November and December, the dry bulb readings were fairly normal; in every other month temperature was steadily in excess, the excess amounting to as much as 4°·4 on a mean of all readings in February and 3°·7 in January. In June and July temperature was more than 2° higher than usual, in the remaining six months the excess varied from 1°·0 to 1°·6. The very high temperatures registered during January and February were undoubtedly due to the entire failure of the preceding north-east monsoon and in June, July and August to the very scanty rainfall during the south-west monsoon of the year under review. The influence which clouds exert on temperature at night by retarding radiation is well exemplified in the months of January, February and March, usually the clearest months in the year. In 1897 skies were clouded more than usual and in consequence temperature at night was in considerable excess, the excess being greater than that shown in the day temperatures. The day temperature anomalies as shown by the maximum thermometer, and the night as shown by the minimum, are given below for these three months:—

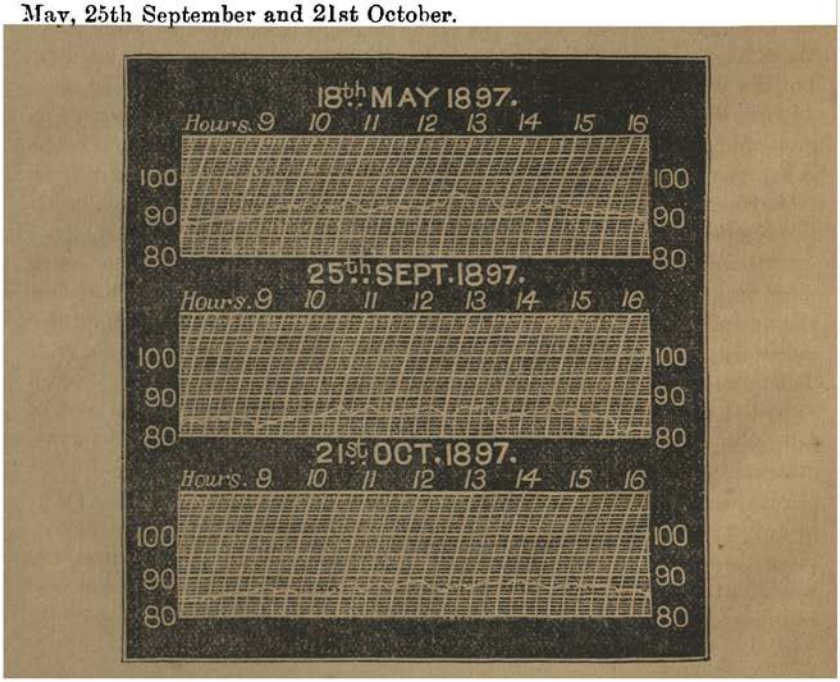
	Day.	Night.
January	+2·7	+5 9
February	+3·5	+5·7
March	+1·1	+2·6

The grass minimum thermometer shows still larger variations from the normal. In January readings of this instrument were on an average for the whole month 5°·1 higher than usual and in February they exceeded the normal by no less than 7°·2.

Temperature conditions continued abnormal during the hot weather and the south-west monsoon period, but with the increase in rainfall in September and the restoration of more normal conditions temperature ceased to exhibit such large variations; and from September to the end of the year, day temperatures were practically normal. As the excess was larger in night than in day temperatures the mean daily range was smaller than usual.

The highest temperature recorded during the year was 105°·4 at 12–15 P.M., on the 25th of June, and the lowest 54°·9 at 6–15 A.M., on the morning of the 20th December.

The self-recording thermograph referred to in last year's Report has been in use from 1st February and has recorded several traces of considerable interest. Some showing the large changes in temperature accompanying nor'westers have been reproduced in a paper on the rainfall of Vizagapatam. The following diagrams may also be of interest, which show some rapid changes in temperature on the 18th May, 25th September and 21st October.



The traces of the 25th September and 21st October bear some resemblance to each other, but the causes of these rapid changes of temperature on these two days are not quite identical. On the 21st October the changes were due to passing clouds which caused temporary falls of temperature. The oscillations are large and sudden, the most extraordinary perhaps being the fall at 12–30 P.M. which amounted to 3° in about ten minutes. On the 25th September, though passing clouds may have affected the temperature to some extent, the chief cause of the irregular trace on this day was the occurrence of frequent light showers, the first one beginning at 9–30 A.M. and the last ending at 4–20 P.M. The influence of these showers is clearly seen in the fall of temperature at 9-30 and the more sudden fall due to the last shower amounting to 3° in a few minutes. This was the heaviest shower received during the day but the rainfall amounted to only a tenth of an inch. Another shower occurred at 13-47 and lasted for ten minutes and an exactly simultaneous fall of temperature is shown in the trace. The remaining oscillations are probably due to passing clouds. The remaining trace of the 18th May also shows changes of temperature; in part due to passing clouds, and in part to distant rainfall, for from 8 A.M. thunder was heard in the distance, though no storm visited Vizagapatam itself.

The readings of the two sets of thermometers, one in the shed in the observatory grounds and the other in the old position in Rani Anitham Atchayyama Garu's drawing-room, were taken during the year, but the readings of the latter set were discontinued from 1st January, 1898, as a sufficient number of simultaneous readings have been secured to give approximately the differences in the conditions of exposure. Table XV gives the corrections that should be applied to the normals calculated from the observations of 1870 to 1895 to render them comparable with the temperatures registered under the new conditions in the shed.

Rainfall.—During the hot weather of 1897 thunderstorms were more frequent than usual and the rainfall of March and May exceeded the normal by 0·82 inch and 1·49 inches respectively. Notes on the more important of these thunderstorms will be found at the end. This abnormally heavy thunderstorm rainfall mitigated to some extent the distress consequent on the scarcity of water caused by the failure of the 1896 north-east monsoon, but it was followed by very defective rainfall in the south-west monsoon. While in May 4·14 inches of rain were received, in June the rainfall amounted to only 0·87 inch, in July to 1·65 inches, and in August to 2·82 inches. The deficiency in these three months expressed as a percentage of the normal rainfall, was 75·21, 69·35 and 50·44 respectively. Happily there was a marked improvement in September, the last month of the south-west monsoon,

when 6·53 inches were received; which, though still below the usual September rainfall, was only 1·47 inches in defect.

The improvement commenced in September continued generally throughout the north-east monsoon period, and though the rainfall in October was 3·77 inches less than it should have been there was an excess of 1·65 inches in November. The whole of the north-east monsoon rainfall amounted to 14·03 inches, which was only 2·79 inches below the normal.

The south-west monsoon commenced on the 15th June with several days light drizzle but up to the 21st there was only one day on which the rainfall exceeded a tenth of an inch. There was practically no more rain till the beginning of July when rainfall increased slightly, but though there were frequent showers they were very light and the rainfall for the whole month amounted to only 1·65 inches. In August the first fairly heavy fall of rain, that of 1·23 inches, was received on the 15th but the total amount recorded during the month was still largely below the normal. Rainfall was much more continuous in September, the principal fall being one of 1·58 inches on the 10th and 11th. The south-west monsoon may be said to have ended on the 26th September and the north-east monsoon to have commenced on the 1st October, ushered in by a storm which crossed the coast to the north and gave Vizagapatam a moderately heavy burst of rain. There was no more rain however till the 16th October from which date up to the 23rd occasional showers were received. November had slightly more rain than usual, the most important fall and the heaviest during the year being one of 3·98 inches in 3¼ hours during the night of the 10th–11th. A light shower was received on the 26th December, the extreme limits of the north-east monsoon thus extending from 1st October to 26th December, a period of 88 days. The number of rainy days on which rainfall amounted to a tenth of an inch or over was however only seven, the average fall per rainy day thus being 2 inches.

The following gives particulars of the rainfall received during the year :—

	Inches received.	Variation from normal.
Thunderstorm rainfall, 1st January to 9th June	5·87	+2·31
South-west monsoon, 10th June to 26th September	11·74	−11·97
North-east monsoon, 1st October to 26th December	14·03	−2·79
Total for year ...	31·64	−12·45

Storms.—Extra storm observations were asked for by the Meteorological Reporter to the Government of Bengal on four occasions during the year, *viz.*, 1st and 2nd October, 17th October, 22nd to 24th November, and 27th December, but the only cyclonic storm that affected the weather at Vizagapatam to any appreciable extent was the one of the 1st to 6th October. The heaviest rainfall in October occurred while this storm was crossing the coast. In five hours from 5 to 10 P.M. on the evening of the 2nd, $2\frac{1}{2}$ inches of rain were received, the total amount recorded during the 1st, 2nd and 3rd being 6·31 inches.

Relative humidity and vapour pressure.—The air was drier than usual during the greater part of the year, especially in December, when the mean relative humidity of the month was only 62. Some low percentages occurred during the month, the most remarkable being—

30 per cent. at 10 A.M. on 16th December.
31 „ „ 17th „

Vapour pressure varied more largely from the normal. During the early part of the year and the south-west monsoon period it was generally in excess, especially in January, February and March; it was normal in October and in defect in November and December.

The variations were largest in the following months:—

January	...	...	+0·077
February	...	...	+0·124
December	...	...	−0·077

Humidity was hence least both relatively and absolutely in the month of December.

Cloud.—Skies were more clouded in 1898 than usual. With the single exception of June, cloud was in excess of the normal throughout the year. The mean excess for the whole year amounted to 0·65. A change in the observation of clouds was made during the year. The nomenclature and mode of observation given in the International Cloud Atlas was adopted from 1st June, under instructions from the Meteorological Reporter to the Government of India.

Waltair Observatory. The observatory on the sand-hills in Waltair referred to in the last Annual Report, is now in working order. Observations of temperature and humidity have been taken at 8 A.M. daily since 1st February and the direction and velocity of the wind has been recorded by Beckley's self-registering Anemograph from 16th March. From the month of July readings of a Dines's Pressure Tube Anemometer have also been taken, but some trouble has been experienced in getting this instrument to work correctly, chiefly owing to the amount of sand which is blown down the tube. The sand interferes with the free movement of the index, necessitating the frequent empty-

ing and cleaning of the glass tube containing it. The instrument thus frequently records velocities which are considerably below the correct amount as shown by the corresponding record given by the Beckley's Anemograph.

Temperature.—The temperatures of the ordinary dry and wet bulb thermometers given in Table X are the monthly means of observations taken at 8 A.M. and the relative humidity and vapour pressure given have been computed from these observations. These figures hence give the conditions obtaining at 8 o'clock in the morning and do not represent the mean of the day as in the corresponding tables for Vizagapatam. The failure of the south-west monsoon rains in June made that month both at Waltair and Vizagapatam the hottest in the year. The highest temperature recorded at Waltair was 100°·6 on the 24th June and the lowest from February to December was 61°·9 on the night of the 21st–22nd December. An unusually low reading for the season of the year was registered by the minimum thermometer on the 4th–5th May, *viz.*, 69°·3, which was about 12° lower than the average for the month. This was due to a thunderstorm with heavy rain on the evening of the 4th.

On comparing the extremes of temperature at Waltair with those recorded at the observatory in Vizagapatam it will be seen that the range of temperature at Waltair is not so great as at Vizagapatam. Thus:—

	Highest Temp. °	Lowest Temp. °	Annual Range. °
Vizagapatam ...	105·4	54·9	50·5
Waltair	100·6	61·9	38·7

A more particular comparison of the temperature conditions of Waltair with Vizagapatam yields some interesting results. In Table XIV the two sets of meteorological conditions are compared with each other and the differences in monthly means shown. Temperature at 8 A.M. is lower at Waltair during the hot weather months, is the same in October, but is higher in the cold weather. The greatest differences occur in April, May and December. In the first two months temperature is 2° lower and in the last 2° higher.

This reversal of differences is most clearly marked in the maximum (or day) temperatures and the minimum (or night) temperatures and are probably due to the same cause, illustrating in a less pronounced form the inversion of temperature relations occasionally observed between the hill and plains stations of Northern India and elsewhere.

The day temperatures recorded at Waltair were throughout the

year lower than those of Vizagapatam, the difference being large during the hot weather months up to June, from which month they gradually decreased, becoming smallest in October and November and again commencing to increase from December. The largest difference was in March, in which month the Waltair day temperatures averaged no less than 6° lower than those of Vizagapatam. Waltair is hence considerably cooler than Vizagapatam during the hot weather.

The differences in the minimum or night temperatures were not so great and in the months of March, April and September the minimum temperature in Waltair and Vizagapatam was practically the same. In May, June, July, and August, Waltair temperatures were about 1° lower than those of Vizagapatam, but from October they were higher, the differences being greatest in December when they averaged $4\frac{1}{2}$°. The following table gives the differences of temperature at Waltair and Vizagapatam.

	Max. or Day Temp. °	Min. or Night Temp. °
February	−2·7	+0·9
March	−6·1	+0·2
April	−4·0	−0·3
May	−3·2	−1·0
June	−3·3	−0·9
July	−2·4	−1·0
August	−2·4	−1·0
September	−1·7	−0·4
October	−0·5	+1·7
November	−0·9	+2·7
December	−1·4	+4·6

While temperature in Waltair on the one hand never rises as high as in Vizagapatam, on the other it never falls as low, the days in the hot weather being cooler and the nights in the cold weather warmer. From last year's observations it would thus appear that Waltair has a more equable climate, the range of temperature being much smaller.

The explanation of the differences between the two stations will probably be found in the nature of their surroundings and in the fact that the Waltair Observatory is on comparatively high ground. Vizagapatam and Waltair are surrounded on three sides by hills and are thus situated in a cup shaped depression, the only open side being that facing the sea. As the Waltair Observatory is on an elevation in this depression the temperatures there during the day are never as high as

in the Vizagapatam Observatory which is situated in a hollow and almost the lowest ground in the depression. The difference in elevation is not however great enough to account for the large differences in temperature in the hot weather months, which are doubtless also partly due to the Waltair Observatory being more freely exposed to the tempering influences of the breeze from the sea. This would also explain why the differences in the colder months are smaller.

During the cold weather nights on the other hand, there must be a gradual flow of the colder and hence heavier air down the slopes of the surrounding hills which settles in the low-lying ground in which the Vizagapatam Observatory is situated, hence causing lower temperatures to be recorded there than at the more elevated Waltair Observatory.

Humidity and Vapour Pressure.—At both Waltair and Vizagapatam vapour pressure was greatest in May and June. The air was dampest however in the months of August and September. Humidity both relative and absolute was at its minimum in December. At Waltair the mean relative humidity during this month was only 55 per cent. and vapour pressure 0·442 inch.

A comparison of Waltair with Vizagapatam (Table XIV) shows that relative humidity at Waltair was greater than at Vizagapatam during the months during which the prevalent wind direction was south-west, *i.e.*, for the months of March to September (See Tables XII and XIII) and less during the remaining months when the prevailing direction was north-east. The difference in humidity percentage was greatest in the months of November (−8) and December (−10). The air at Waltair was hence damper during the hot weather and south-west monsoon and drier in the north-east monsoon and cold weather months.

Vapour pressure was practically the same at both places during the months of July and August, but during the remaining months of the year it was lower in Waltair than at Vizagapatam. The difference was again greatest in November (−0·047″) and December (−0·040″).

Wind.—A proper record of the direction and force of the wind is now being obtained for the first time by means of the anemograph in the Waltair Observatory, where the exposure conditions are practically perfect. Table XI gives the mean velocity in miles per hour for the month for every hour of the twenty-four, Table XII gives the resultant direction for every hour and the equivalent miles of air movement in that direction, calculated from the number of miles recorded under each point of the compass. Table XIII gives the resultant and percentage calculated from the number of hours the wind blew from each of the various directions. A complete year's record

has not yet been obtained, as the anemograph was not in proper working order till the 1st April, from which date observations have been given, but the results, incomplete though they are, present several interesting features. Winds were strongest in May, the average velocity for the whole month being 19 miles per hour. June showed the next highest average velocity, *viz.*, 17 miles. In April, July, August, November and December the force of the wind was almost the same, varying from 14 to 15 miles an hour. The months of least wind movement were September and October. The highest velocity registered by Dines's pressure tube anemometer was one of 56 miles on the 3rd and 4th August. The extremely unsatisfactory nature of the wind observations hitherto registered at the observatory in Vizagapatam is well shown by the velocity recorded there for May, which amounted to only 2·83 miles per hour, or rather less than a sixth of that registered at Waltair.

Though, owing partly to the physical conformation of the coast line, and also to the general distribution of pressure over the Indian region, the alternation of land and sea breezes is almost indistinguishable at Waltair, the cause which usually produces them is clearly seen in its effects upon the velocity of the wind and the manner in which this velocity varies with each hour of the twenty-four. In May, the month in which solar insolation is at its maximum in the land area in the interior, the velocity of the wind also reaches its maximum. In 1897 the force of the wind was almost as great in June, which is possibly not the case in normal years; but which in 1897, a year of abnormally high temperature due to scanty rainfall, is what might have been expected. The variations in the velocity of the wind from hour to hour exhibit the effect of the expansion of the atmosphere by the sun's rays and conduction from the heated surface of the land, in a still more marked degree.

Table XI gives the mean wind velocity for each hour for the months April to December. The means for the whole nine months are as follow :—

Hours.	Miles per hour.	Hours.	Miles per hour.
0-1 ...	10	3-4 ...	10
1-2 ...	10	4-5 ...	10
2-3 ...	10	5-6 ...	10

Hours.	Miles per hour.	Hours.	Miles per hour.
6–7 ...	10	15–16 ...	20
7–8 ...	11	16–17 ...	18
8–9 ...	13	17–18 ...	16
9–10 ...	15	18–19 ...	13
10–11 ...	16	19–20 ...	13
11–12 ...	20	20–21 ...	12
12–13 ...	21	21–22 ...	11
13–14 ...	21	22–23 ...	11
14–15 ...	20	23–24 ...	11

The above gives a fair idea of the hourly changes in velocity, as the changes are very similar for each of the nine months, which differ very little from each other in the hours when the velocity increased and diminished. Throughout these nine months wind was generally lightest from midnight to 7 A.M. From 8 A.M. wind increased perceptibly in strength and was strongest from 10 A.M. to 5 P.M., when it began falling off and gradually grew weaker till it again attained its minimum at midnight. The maximum velocity of the twenty-four hours was invariably registered between the hours of noon and 2 P.M. It will thus be seen how closely the wind velocity corresponds with the daily range of temperature, the velocity being least during the hours of minimum temperature and greatest when temperature is at its highest.

Turning to Table XII which gives the resultant wind direction for each hour of the day for the months April to December, it will be seen that though the diurnal changes of temperature do not produce a complete reversal in the wind direction as in the case of the true land and sea breezes, they do exert an unmistakeable influence on the direction of the wind. The hourly changes correspond with the changes in the strength of the wind and are remarkably alike in months during which the prevalent wind direction is the same. The changes hence resemble each other closely in the months of April to September and are again

alike in November and December. In October, the transition period between the south-west monsoon and the complete establishment of the north-east monsoon, the diurnal changes as might be expected do not resemble those of any of the remaining eight months. The winds in October, 1897, were very variable as will be seen from the percentages given in Table XIII.

The diurnal changes in the wind direction can best be studied in a graphic form and diagrams have hence been prepared showing them for each month (Plate I). During the period of steady south-west winds from April to August, 1897, the direction of the wind at night and early morning when temperature was at its minimum was from the south-west. As temperature during the day increased and the surface of the land acquired a higher temperature than that of the sea, the wind backed from south-west to south, the change commencing in each of these months between the hours of 8 and 10 A.M. The wind continued from the south all day and returned to a south-westerly direction at about 8 or 9 P.M., when the surface of the land had commenced cooling down. The change in direction was most strongly marked in the hot weather months of April and May and was not so clearly perceptible in June, July and August, when owing to the rains the difference in temperature of land and sea had decreased. In September, when the area of lowest pressure began moving southwards, there was a change in the direction of the wind. During the night and early morning the prevailing wind direction was westerly instead of south-westerly, as in the preceding months, and the diurnal rise in temperature caused a larger shift of the wind during the day to south-south-east, these changes corresponding with the change in pressure distribution. In October winds were very variable. The mean pressure distribution of the month for 8 A.M., given in the *India Monthly Weather Review* for October, 1897, shows a clearly defined area of low pressure to the east and north-east of Vizagapatam. Hence the wind direction during the night and early morning during October was north-westerly, which changed to north and then to east as temperature rose during the day. Rainfall in the central and southern districts of the Madras Presidency was less than usual during this month and temperature higher; conditions were thus favourable for easterly winds at Vizagapatam during the hours of maximum temperature, and probably the wind direction was more easterly in 1897 than in years of normal rainfall and temperature. The changes of wind direction in November and December, 1897, when the north-east monsoon winds were fully established over the Bay, were not large in amount and were practically identical in character. In both months winds blew from the north-north-east during the night and early

morning, conformably with a pressure distribution in which the area of lowest pressure lay over the south of the Bay; and from the north-east during the day when it is reasonable to suppose that the rise in temperature caused a shifting of the low pressure area slightly to the west.

It will thus be seen that though a more or less complete diurnal reversal in wind direction in the form of land and sea breezes is not known in this part of the coast, the records furnished by the anemograph on the sand hills at Waltair show that the diurnal changes in temperature do exert an unmistakable influence on the direction of the wind.

THUNDERSTORM OBSERVATIONS, 1897.

1st April:—Clouds commenced gathering to the north-west at about 7-30 P.M. Sheet lightning frequent. The sky soon clouded over and was completely overcast by 8-45 P.M. Rain commenced falling a few minutes before 9 P M and continued till 9-30 P.M. Amount registered in half an hour was 0·25 inch. Pressure rose suddenly and irregularly from 8 P.M. to 8-50 P.M. when it stood steady at 29·890″ up to 9-15 P.M., and then began to fall. Pressure at 10 P.M. (time of second maximum) was 29·870″. At 9 P.M. it was ·070 inch higher than it was the same hour the day before. There was no thunder during the rain and lightning decreased considerably. Sky cleared rapidly and was clear enough for photography by 10 P.M. Wind was south-west all day. At 8 P.M. it began veering from south-west to west then to north. At 9 P.M. it changed from north to east and went back to south-west by 10-45.

8th April:—The morning was unusually close and sultry. In afternoon (3-5 P.M.) distant thunder was heard and a cool breeze sprang up which lowered temperature considerably. Thermograph trace was extraordinarily jerky especially that of the wet bulb, the most extraordinary oscillation being one at 4-15 P.M. when temperature went up 2° and came down again in the space of about 2 minutes. At night the wet bulb trace is usually very steady but on this occasion it was almost as jerky as during the day. Only distant thunder was heard. There was no rain.

4th May:—At 4 P.M. lower clouds were moving rapidly from south-west and the upper clouds from north. Alto-cumulus clouds rapidly changed to nimbus and frequent sheet lightning was seen all over the sky. Sky was overcast by 7-20 P.M. when there was a strong gust of wind, and a drizzle commenced which increased to heavy rain lasting for about thirty-five minutes and amounting to 1·09 inches. There was hardly any wind till the storm broke when wind blew in heavy gusts.

Almost continuous lightning but very little thunder. There were occasional flashes of forked lightning but mostly sheet. Large fall of temperature from 7-30 P.M. to 7-45 P.M. In about fifteen minutes dry bulb fell nearly 15° from 87°·0 to 71°·7. Barometer commenced rising rapidly at 7-20 (exactly when rain commenced) and rose 0·080″ in ten minutes.

5th May :—Clouds commenced gathering in the north-west at 5 P.M. with sheet lightning. In fifteen minutes sky clouded over except in the south-east where it remained clear. Rain commenced falling at about 7-50 P.M. and lasted fifteen minutes. During the rain there was a strong wind. There was much more lightning than thunder. Pressure rose 0·070″ in about fifteen minutes from 7-45 P.M. to 8 P.M. Temperature fell 2° at 8 P.M. Rainfall amounted to 0·25 inch.

11th May :—At 4 P.M. cumulus clouds were observed in the lower part of the horizon to the north and cirrus clouds moving from south-west in all parts of the sky. At 5-30 P.M. nimbus clouds appeared to the west and cumulus clouds were observed moving rapidly in different directions. At 6 P.M. the sky had clouded over and thunder and lightning had commenced in the distance. There was much less thunder than lightning, which was continuous. Clouds came up from the north-west and brought rain at 7-20 P.M. Pressure commenced rising at 6-7 P.M. and rose a tenth of an inch in an hour. The rise of pressure was not so rapid as on other occasions. Temperature fell suddenly as storm broke, the fall amounting to 8° in as many minutes. A further fall of about 4° took place at 7-30 P.M., but as the wind began to blow more from the north the breeze became warmer and caused temperature to rise about 4° falling again with change of wind to north-east by another $6\frac{1}{2}$°. At 7-55 P.M. the minimum temperature of the whole twenty-four hours was recorded. The net fall of temperature in one hour was 13°. Rainfall amounted to 0·24 inch.

13th May :—The day had been hotter than usual, the maximum temperature having been 99°·7. At 4 P.M. cumulus clouds were observed in the north-west and a few cirrus clouds in the zenith. After 5 P.M. cumulo-nimbus clouds came up from north-west and north-east. The bank of clouds to the north-east looked most threatening with a dull red glow beneath. It came up rapidly and caused a moderately severe dust-storm with change of wind to north-west, north and north-east. When these clouds had passed over another bank of cloud came up from the north-east accompanied by distant thunder and lightning. There was a light drizzle for a few minutes. A hot dry land breeze then blew for some hours from west, shifting to south-west by early morning. At 5-55 P.M. when the dust-storm commenced temperature fell from 90° to 85·7° and rose again when the hot wind com-

menced to 94°5 (at 7-30 P.M.). The thermograph trace was very jerky up to about 9-30 P.M. when temperature began again to fall and fell as low as 85° by midnight. It then again began to be unsteady and continued rising and falling up to 5-30 A.M. From 5 P.M. to 6 P.M. pressure rose a tenth of an inch. At 7-15 P.M. the air was very dry, the humidity percentage being only 26.

16th May:—After 5-30 P.M. cumulo-nimbus clouds were seen in the north-west horizon, and cumulus in all parts of the sky. A bank of nimbus rose suddenly from the north-west horizon and extended to the zenith, accompanied by a few drops of rain. At about 6-30 P.M. there was a gust of strong wind from the north-west. The cumulo-nimbus clouds to the north-west gradually changed to nimbus passing to the south-east which had up to that time been clear. Rain commenced falling at 7-40 P.M., with distant thunder and lightning, but only 0·26 inch of rain was registered. The barograph trace was as usual unsteady during the storm. Pressure commenced rising at 5 P.M. and by 8-45 P.M. had risen as much as two-tenths of an inch. This large rise was probably due to the fact that the storm occurred later than usual, about the time of the night maximum, and the rise was hence due to two causes. Temperature commenced falling at about 6-35 P.M. and fell 9° in two hours, the fall thus being very gradual on this occasion. At 11 P.M. a hot dry wind caused a rise in temperature of $6\frac{1}{2}$° in less than an hour, but temperature then fell suddenly by 4° in about ten minutes and continued to rise and fall by small amounts all night.

19th May:—An unusually strong wind had been blowing all day the average velocity from 6 A.M. to 5 P.M. being 32 miles per hour. At 4 P.M. the sky was covered with a thin veil of cirro-stratus with cumulo-nimbus on the western part of the horizon and also to a small extent on the northern and southern. The east was comparatively clear. Clouds gradually grew thicker till, at about 6 P.M., the sky was overcast with dense masses of cumulo-nimbus, flying across from the south-west. At 7 P.M. thunder and lightning commenced and at 7-30 P.M. rain began falling, the wind being in the south-east but rapidly changing to east, then to north-east, and then to north after which it shifted to north-west and blew for the rest of the night from directions between west and south-west. The rainfall was heavy but not continuous, on three occasions there being an almost complete cessation. From 7-30 P.M. to 10-10 P.M., 2·15 inches of rain fell. Lightning was incessant during the whole time the storm lasted, chiefly sheet, though there were occasional flashes of forked lightning which were followed by moderately loud peals of thunder; but judging from the intervals between them the thunder clouds could not have been very near. Pressure commenced rising at

6 P.M. and reached its maximum at 10-10 P.M., the rise during these four hours amounting to 0·170 inch. Pressure was most unsteady between 9-15 P.M. and 10-30 P M. when the wind was blowing from the north-east, north, and north-west. In the early morning between 5 A.M. and 6 A.M. the wind again shifted to a northerly direction and pressure again showed symptoms of unsteadiness. Temperature fell only about 2° a few minutes after the rain commenced and the wet bulb remained unchanged until 8-15 P.M., when both wet and dry fell rapidly, the fall of the former in half an hour being 11°. This coincided with the time when the wind commenced to change from south-east to east and then to north. Wind was strongest from 8 P.M. to 9 P.M. during which time the air movement amounted to 34 miles. Wind was moderately strong during the whole of the storm, blowing in hard gusts, but its average velocity was not so great as it had been during the day.

27th May:—At 4 P.M. a bank of clouds was lying over the horizon to the west and north-west which gradually increased in extent and thickness. By 7 P.M. it commenced moving up in a south-easterly direction and gave light rain for a few minutes. The rain then stopped and after a few minutes interval another cloud came up and gave a little heavier shower. Total rain registered was 0·14 inch. Temperature commenced falling at 7-10 P.M. and fell 7½° in twenty minutes. Pressure reached its nocturnal maximum at 7-30 P.M. and was 0 050 inch lower at 10 P.M.

2nd June:—At 4 P.M. cumulo-nimbus clouds with cirrus looking edges covered the north-west part of the sky and gradually increased, covering the whole sky by 5-30 P.M. At 6 P.M. a heavy bank of cloud (nimbus cumuli-formis) appeared in the northern sky clearly defined against the back ground of cumulo-nimbus, and gradually moved upwards towards the zenith, a reddish glow appearing beneath caused by advancing clouds of dust. A light shower fell with a gust of wind from the north, and lasted for an hour. The peals of thunder were not very loud nor frequent. The flashes of sheet lightning were very frequent, but there were only a few flashes of forked lightning. One flash of forked lightning which appeared to the south was particularly vivid, having the appearance of a broad ribbon perpendicular to and extending below the horizon. The colour of some flashes approached a light mauve, possibly due to the amount of dust in suspension in the atmosphere. Barograph trace was jerky from 3 P.M. to 8 P.M. Pressure commenced rising from about 5 P.M. reaching its maximum at 7-30 P.M. The difference between the two readings amounted to 0·110″. Temperature fell at 6 P.M. and in the course of half an hour had fallen 7½°. Rainfall amounted to 0·13 inch.

SUMMARY OF ABNORMAL FEATURES IN THE METEOROLOGY OF 1897.

Comparison of monthly means of 1897 *with the normals.*

Month.	Pressure reduced to 32°.	Temperature of Air.				Nocturnal Radiation.		Temperature of Evaporation.	Hygrometrical Results.		Cloud (overcast = 10.)	Rainfall.	Rainy days.
		Mean of Dry Bulb.	Mean of Maximum.	Mean of Dry Minimum.	Mean of daily range.	Grass minimum.	Difference Shade and Radiation.	Wet Bulb.	Humidity percentage (Saturation = 100).	Vapour pressure.			
January ...	−·012	+3·7	+2·7	+5·9	−3·2	+5·1	+0·8	+3·4	+1	+·077	+0·6	−0·17	+0·04
February ...	−·059	+4·4	+3·5	+5·7	−2·2	+7·2	−1·5	+4·4	+1	+·124	+1·3	−0·15	−0·06
March ...	−·022	+1·6	+1·1	+2·6	−1·5	+2·6	0	+1·7	+1	+·055	+1·3	+0·82	+2·19
April ...	+·036	+1·2	+0·1	+1·1	−1·0	0	+1·1	+0·5	−2	+·008	+0·1	−0·50	+0·01
May ...	+·002	+1·2	+0·1	+0·9	−0·8	+0·6	+0·3	+1·2	+2	+·045	+0·2	+1·49	+2·19
June ...	−·023	+2·5	+2·4	+2·7	−0·3	+2·5	+0·2	+1·7	−3	+·040	−0·3	−2·64	−4·73
July ...	+·015	+2·1	+1·5	+2·1	−0·6	+0·6	+1·5	+1·2	−3	+·027	+0·8	−3·08	−1·73
August ...	−·007	+1·6	+1·5	+1·5	0	+1·2	+0·3	+0·7	−3	+·006	+0·9	−2·87	−6·31
September ...	+·036	+0·2	−0·6	+0·6	−1·2	+0·5	+0·1	+0·8	+3	+·033	+1·2	−1·47	+0·31
October ...	−·031	+1·5	+0·7	+1·6	−0·9	+0·4	+1·2	+0·3	−4	+·001	+0·7	−3·78	−4·77
November ...	−·024	+1·0	+0·5	+1·7	−1·2	−0·4	+2·1	−0·3	−4	−·025	+0·5	+1·65	+0·15
December ...	−·006	+0·3	−0·4	0	−0·4	−2·9	+2·9	−2·2	−8	−·077	+0·5	−1·74	−1·35

PRESSURE (*reduced for* 32°).

1897.	Mid Night.	1	2	3	4	5	6	7	8	9	10	11
	29+	29+	29+	29+	29+	29+	29+	29+	29+	29+	29+	29+
January ...	?	?	?	?	·953	?	?	?	1·033	?	1·046	?
February ...	·900	·890	·870	·860	·860	·860	·885	·910	·940	·950	·963	·950
March ...	·870	·850	·830	·820	·817	·830	·850	·840	·902	·920	·921	·874
April ...	·840	·823	·785	·795	·797	·805	·826	·846	·875	·886	·884	·874
May ...	·708	·603	·670	·655	·659	·668	·692	·710	·729	·743	·741	·732
June ...	·589	·576	·568	·561	·559	·563	·577	·588	·609	·609	·608	·593
July ...	·607	·595	·585	·583	·597	·585	·593	·597	·641	·640	·639	·631
August ...	·636	·625	·613	·607	·608	·611	·629	·650	·664	·670	·668	·671
September ...	·743	·728	·714	·707	·704	·712	·725	·744	·772	·781	·784	·777
October ...	·804	·786	·771	·759	·758	·766	·784	·804	·833	·843	·842	·832
November ...	·925	·913	·895	·886	·854	·889	·905	·929	·921	·962	·930	·949
December ...	1·006	·996	·984	·961	·931	·965	·981	1·012	1·011	1·052	1·020	1·038

1897.	Noon	13	14	15	16	17	18	19	20	21	22	23	Mean
	29+	29+	29+	29+	29+	29+	29+	29+	29+	29+	29+	29+	
January...	?	?	?	?	·927	?	?	?	?	?	1·002	?	·982*
February.	·920	·895	·865	·840	·835	·840	·860	·870	·890	·910	·917	·910	·891
March ...	·880	·835	·824	·800	·796	·800	·810	·836	·855	·880	·880	·880	·850
April ...	·859	·826	·800	·775	·766	·767	·781	·806	·825	·845	·848	·852	·824
May ...	·716	·687	·662	·640	·623	·626	·640	·668	·688	·710	·717	·715	·683
June ...	·578	·559	·543	·528	·510	·517	·533	·531	·571	·586	·600	·594	·569
July ...	·598	·578	·561	·542	·551	·533	·545	·569	·587	·607	·640	·618	·593
August ...	·638	·614	·590	·571	·558	·568	·582	·602	·621	·642	·660	·652	·623
September	·757	·729	·704	·681	·667	·682	·694	·717	·737	·756	·758	·757	·720
October...	·805	·778	·752	·735	·733	·744	·757	·786	·805	·824	·821	·820	·789
November	·923	·896	·865	·857	·826	·866	·882	·903	·928	·936	·910	·935	·904
December	1·013	·985	·953	·941	·909	·949	·963	·982	1·008	1·021	·991	1·020	·987

Mean of 4, 10, 16 and 22 Hours.

TEMPERATURE—DRY BULB.

1897.	Mid Night.	1	2	3	4	5	6	7	8	9	10	11
January ...	?	?	?	?	69·8	?	?	?	73·3	?	81·1	?
February ...	78·3	77·8	77·1	76·5	75·8	75·1	74·2	74·8	79·1	82·9	85·6	86·9
March ...	79·8	79·1	78·6	78·1	77·5	76·9	76·5	78·1	81·6	84·4	86·8	88·0
April ...	82·4	82·1	81·6	81·1	80·6	80·3	80·0	82·5	85·9	88·9	91·1	91·3
May ...	84·6	84·4	84·2	84·0	83·8	83·8	84·1	86·2	88·5	90·8	92·0	93·1
June ...	85·7	85·5	85·2	84·8	84·7	84·5	84·6	86·1	88·5	91·0	92·6	94·1
July ...	82·7	82·3	82·0	81·8	81·5	81·3	81·3	82·1	84·1	86·2	87·7	88·5
August ...	82·5	82·2	81·6	81·1	80·6	80·5	80·4	81·6	83·4	85·1	86·9	85·1
September ...	80·4	80·2	79·8	79·6	79·4	79·1	79·0	79·9	81·9	83·0	84·6	85·7
October ...	79·4	78·7	78·2	77·9	77·4	76·8	76·9	78·8	81·6	84·1	85·7	86·7
November ...	73·9	72·7	72·7	72·4	72·1	71·7	71·4	72·8	76·7	79·7	81·8	82·8
December ...	67·9	67·3	66·8	66·2	65·8	65·3	64·7	65·6	70·6	75·2	78·0	80·0

1897.	Noon	13	14	15	16	17	18	19	20	21	22	23	Mean
January...	?	?	?	?	81·6	?	?	?	?	?	74·4	?	76·7*
February.	87·5	87·3	87·2	86·6	85·7	83·5	81·8	81·0	80·4	79·8	79·5	78·9	81·0
March ...	88·4	88·3	88·1	87·2	86·1	84·4	82·8	82·1	81·7	81·2	80·9	80·4	82·4
April ...	91·2	91·4	91·2	87·4	89·5	87·5	85·9	85·0	84·4	83·8	83·0	82·8	85·5
May ...	93·0	92·9	92·4	91·6	90·6	89·2	87·8	87·1	85·9	85·2	85·1	84·9	87·7
June ...	94·6	93·9	93·7	92·3	91·5	89·5	88·3	87·3	86·9	86·4	86·1	85·9	88·5
July ...	89·2	89·2	89·8	89·7	88·9	87·2	85·7	84·9	84·4	83·9	83·5	83·0	85·0
August ...	88·8	89·5	89·9	89·6	88·7	87·1	85·5	84·4	84·0	83·7	83·4	82·8	84·5
September	86·3	86·2	86·5	86·2	85·8	85·2	83·4	82·6	82·2	81·7	81·0	80·8	82·5
October ...	87·2	87·3	87·6	86·8	85·9	84·3	82·6	81·6	81·0	80·4	79·8	79·3	81·9
November	83·7	84·0	83·7	83·2	81·8	80·0	78·7	77·5	78·3	75·8	75·2	74·8	77·4
December	81·1	82·2	80·6	80·0	78·5	76·4	74·8	73·8	72·9	71·5	70·3	69·2	72·7

* Mean of 4, 10, 16 and 22 Hours.

TEMPERATURE (*continued.*)

1897.	Dry maximum.	Dry minimum.	Range.	Highest maximum.	Lowest minimum.	Absolute monthly range.	Temperature of radiation.			
							Solar.		Nocturnal.	
							Sun thermometer.	Difference, sun and shade.	Grass minimum.	Difference, shade and radiation.
January ...	84·4	67·5	16·9	90·0	60·7	29·3	139·8	55·4	60·4	7·1
February ...	88·9	73·5	15·4	95·1	66·5	28·6	144·6	55·7	67·3	6·2
March ...	90·0	75·7	14·3	93·5	72·0	21·5	145·3	55·3	69·8	5·9
April ...	93·7	79·1	14·6	97·9	73·6	24·3	147·9	54·2	73·4	5·7
May ...	94·9	82·2	12·7	99·7	71·8	27·9	147·4	52·5	78·4	3·8
June ...	96·7	83·4	13·3	105·4	77·5	27·9	149·1	52·4	80·5	2·9
July ...	91·9	80·2	11·7	101·0	76·0	25·0	141·4	49·5	76·6	3·6
August ...	92·0	79·4	12·6	100·0	76·2	23·8	146·5	54·5	76·8	2·6
September ...	88·6	77·7	10·9	93·9	74·0	19·9	145·4	56·8	75·4	2·3
October ...	88·9	75·7	13·2	93·1	63·7	29·4	143·7	54·8	71·6	4·1
November ...	84·9	69·8	15·1	90·3	63·8	26·5	144·1	59·2	63·8	6·0
December ...	81·7	62·7	19·0	87·5	54·9	32·6	140·9	59·2	55·4	7·3

TEMPERATURE OF

Months.	Mid Night	1	2	3	4	5	6	7	8	9	10	11
January ...	?	?	?	?	67·6	?	?	?	69·2	?	71·2	?
February...	73·9	73·8	73·4	73·1	72·8	72·1	71·5	71·8	74·3	75·1	75·5	76·0
March ...	75·5	75·1	74·8	74·6	74·2	73·7	73·2	73·9	75·7	76·0	76·3	77·1
April ...	77·6	77·4	77·3	76·9	76·6	76·1	75·7	76·7	77·8	78·1	78·6	78·9
May ...	79·7	79·7	79·8	79·6	79·6	79·5	79·4	80·2	80·9	81·3	81·6	81·8
June ...	79·9	80·1	79·9	79·8	79·4	79·4	79·3	79·8	80·3	80·7	81·2	81·5
July ...	77·8	77·4	77·2	77·0	77·2	76·8	76·8	77·4	78·3	79·1	79·8	80·1
August ...	78·0	77·9	77·7	77·5	77·4	77·1	77·1	79·8	78·1	78·7	79·0	79·7
September..	78·1	78·0	77·8	77·7	77·7	77·5	77·4	77·6	78·2	78·6	79·2	79·5
October ...	75·7	75·5	75·1	75·2	75·1	75·0	74·9	75·7	76·4	76·9	77·0	77·0
November..	69·9	69·5	69·1	68·7	68·3	68·1	67·9	68·5	70·0	70·6	70·9	71·2
December...	62·9	62·5	62·0	61·5	61·0	60·6	60·6	61·0	63·1	64·0	64·5	65·5

RELATIVE HUMIDITY

January ...	?	?	?	?	89	?	?	?	31	?	60	?
February...	80	82	83	84	86	86	87	86	80	68	61	58
March ...	81	82	83	84	85	85	85	81	75	66	60	59
April ...	80	80	82	82	83	81	81	76	68	60	56	56
May ...	79	80	81	81	82	82	80	76	71	65	63	60
June ...	77	78	78	79	78	79	78	75	69	62	60	57
July ...	79	79	80	80	82	81	81	80	76	72	70	68
August ...	81	82	83	85	86	85	86	92	78	75	70	77
September	90	90	91	91	92	93	93	90	84	81	78	75
October ...	84	86	86	88	90	92	91	86	78	71	66	63
November	81	85	83	82	82	83	83	79	71	61	57	55
December	74	75	75	75	76	75	78	75	65	51	45	43

EVAPORATION—WET BULB.

Noon	13	14	15	16	17	18	19	20	21	22	23	Mean	Wet Min.
?	?	?	?	72·0	?	?	?	?	?	70·1	?	*70·2	66·3
76·5	76·8	76·8	76·7	76·1	75·4	74·7	74·7	74·5	74·4	74·7	74·4	74·5	71·6
77·4	77·4	77·5	77·1	76·8	76·4	75·9	75·8	75·8	76·0	76·0	75·8	75·8	73·3
79·0	79·1	79·1	78·8	78·4	78·1	77·6	77·5	77·7	77·6	77·7	77·6	77·7	75·5
81·9	82·3	82·3	82·3	82·0	81·6	81·0	80·9	80·1	80·1	79·8	79·9	80·7	77·4
81·8	81·7	81·7	81·4	81·1	80·7	80·2	80·1	80·1	80·0	80·2	80·0	80·4	78·2
80·3	80·4	80·3	80·2	79·9	79·3	79·0	78·7	78·5	78·6	78·4	78·1	78·6	76·1
80·0	79·9	79·9	77·2	79·3	78·8	78·4	78·2	78·2	78·2	78·2	78·1	78·4	76·6
79·8	79·7	79·8	79·9	79·5	79·2	78·8	78·6	78·5	78·4	78·4	78·2	78·6	76·6
77·2	77·3	77·4	77·2	77·1	76·6	76·1	75·8	75·8	75·7	75·5	75·4	76·1	74·1
71·6	72·1	72·1	72·1	71·7	71·3	71·0	70·8	70·7	70·5	70·5	70·2	70·3	67·4
65·8	66·2	66·5	66·6	66·4	65·8	65·5	66·0	65·4	64·6	64·3	63·8	64·0	59·8

(*Saturation* = 100).

?	?	?	?	61	?	?	?	?	?	79	?	*72	†94
59	60	61	61	63	67	71	73	74	76	79	80	74	91
59	60	60	62	64	68	71	74	75	78	79	80	73	89
57	56	57	67	59	64	67	70	73	74	78	78	70	84
61	62	64	66	68	71	73	75	77	79	79	79	73	80
56	58	58	61	63	67	69	72	73	74	77	76	70	78
66	67	65	65	67	69	73	75	75	78	79	79	74	82
67	65	63	55	65	68	72	75	76	77	78	83	76	88
74	74	73	75	75	76	81	83	84	86	89	89	84	94
62	62	61	63	66	69	73	76	77	79	81	83	76	93
53	54	55	57	60	63	67	70	67	76	79	79	70	88
41	39	44	47	50	55	58	64	65	67	71	73	62	85

* Mean of 4, 10, 16 and 22 Hours. † From wet minimum.

VAPOUR

Months.	Mid night	1	2	3	4	5	6	7	8	9	10	11
January ...	?	?	?	?	·648	?	?	?	·661	?	·635	?
February...	·779	·781	·774	·770	·769	·749	·737	·741	·789	·767	·749	·751
March ...	·826	·819	·812	·811	·801	·790	·774	·782	·821	·785	·766	·784
April ...	·883	·878	·880	·869	·860	·845	·832	·842	·845	·817	·811	·821
May ...	·950	·952	·960	·953	·958	·951	·942	·951	·957	·941	·944	·934
June ...	·944	·956	·951	·951	·938	·937	·931	·933	·925	·910	·910	·906
July ...	·888	·876	·871	·864	·876	·862	·862	·878	·886	·900	·908	·915
August ...	·899	·899	·898	·896	·900	·886	·888	·995	·894	·896	·891	·943
September.	·933	·931	·927	·925	·928	·923	·920	·916	·919	·920	·926	·925
October ...	·841	·841	·831	·839	·849	·845	·840	·848	·849	·829	·818	·798
November..	·679	·680	·664	·653	·647	·640	·637	·640	·647	·628	·613	·609
December..	·508	·503	·493	·485	·477	·468	·476	·477	·482	·448	·432	·436

CLOUD PROPORTION (0–10.)

Months.	4	8	10	16	22	Mean.
January	1·2	2·1	3·0	2·1	2·4	2·2
February	2·6	3·0	3·1	2·5	3·0	2·8
March	2·5	3·8	3·8	3·2	3·5	3·3
April	2·2	3·7	3·2	3·5	3·2	3·0
May	4·3	5·5	4·8	4·2	5·2	4·6
June	5·5	6·5	5·5	6·7	5·8	5·9
July	7·6	8·2	7·6	8·7	7·4	7·8
August	7·0	8·4	8·5	8·1	6·8	7·6
September	6·8	8·0	8·2	7·3	6·1	7·1
October	4·5	5·1	5·9	5·9	5·3	5·4
November	3·3	3·3	4·1	3·9	3·7	3·8
December	2·3	3·5	3·4	3·5	2·9	3·0

PRESSURE.

Noon	13	14	15	16	17	18	19	20	21	22	23	Mean.	From Wet Min.
?	?	?	?	·659	?	?	?	?	?	·678	?	*·655	·633
·765	·781	·782	·786	·773	·772	·765	·776	·775	·780	·799	·792	·771	·755
·792	·794	·801	·796	·799	·803	·803	·808	·814	·829	·832	·831	·803	·791
·827	·829	·832	·869	·822	·836	·835	·844	·860	·864	·882	·878	·848	·839
·940	·961	·968	·979	·981	·978	·967	·972	·950	·960	·954	·955	·957	·884
·914	·918	·921	·925	·922	·930	·922	·932	·937	·938	·952	·945	·931	·897
·915	·919	·907	·904	·901	·895	·902	·899	·896	·908	·906	·897	·893	·846
·906	·892	·887	·768	·876	·873	·877	·883	·888	·892	·895	·927	·894	·879
·930	·927	·928	·937	·926	·918	·924	925	·926	·929	·938	·932	·926	·904
·800	·803	·804	·806	·821	·813	·814	·815	·822	·827	·833	·829	·826	·828
·613	·629	·633	·639	·644	·651	·657	·665	·650	·676	·681	·678	·648	·643
·431	·431	·463	·475	·493	·494	·505	·536	·527	·518	·522	·522	·483	·482

HOURS OF SUNSHINE.

Month.	Average per day.	Greatest number of hours in one day.
	H. M.	H. M.
January ...	9·01	10·15
February ...	8·49	10·30
March ...	8·28	10·40
April ...	8·37	11·5
May ...	8·3	10·10
June ...	5·47	9·50
July ...	3·3	11·20
August ...	3·39	9·30
September ...	4·30	10·30
October ...	6·2	11·15
November ...	7·32	10·45
December ...	8·18	10·25

AMOUNT OF EVAPORATION.

Month.	Average per day.
January ...	·226
February ...	·265
March ...	·277
April ...	·308
May ...	·313
June ...	·303
July ...	·246
August ...	·234
September ...	·181
October ...	·214
November ...	·268
December ...	·273

* Mean of 4, 10, 16 and 22 Hours.

Rainfall.			Rainy Days.	
Month.	Rainfall during the month.	Heaviest fall in one day.	Month.	Rainy days in the month.
January	0·14	0·13	January	1
February	0	0	February	0
March	1·22	0·81	March	3
April	0·25	0·25	April	1
May	4·14	2·15	May	6
June	0·87	0·42	June	2
July	1·65	0·25	July	8
August	2·82	1·23	August	4
September	6·53	1·50	September	11
October	7·41	4·78	October	5
November	6·54	4·23	November	5
December	0·08	0·08	December	0

WALTAIR OBSERVATORY.

Observations taken at 8 A.M.

Months.	Temperature.					Humidity.		Wind.			
								Beckley's Anemograph.		Dines's Pressure Tube Anemometer.	
	Dry Bulb.	Wet Bulb.	Dry Maximum.	Dry Minimum.	Wet Minimum.	Percentage of Saturation.	Vapour Pressure.	Mean Hourly Velocity in miles.	Resultant Direction at 8 A.M.	Maximum* during past 24 hours. (Miles.)	Mean during past 24 hours. (Miles.)
January ...	...	...	...	...	...	...	...	...	.....	...	...
February ...	78·4	73·5	86·2	74·4	70·8	78	·761	...	.....	...	...
March ...	80·1	74·7	83·9	75·9	72·3	76	·788	...	.....	...	...
April ...	83·8	76·5	89·7	78·8	73·8	70	·815	14	S. 57°56′ W.	...	...
May ...	86·5	79·9	91·7	81·2	75·5	74	·933	18	S. 46°5′ W.	...	...
June ...	87·0	79·4	93·4	82·5	73·4	70	·903	17	S. 46°45′ W.	...	...
July ...	82·6	77·6	89·5	79·2	74·6	79	·881	15	S. 59°9′ W.	33·1	18·5
August ...	82·0	77·6	89·6	78·4	75·1	81	·888	16	S. 54°32′ W.	36·3	21·0
September ...	80·8	77·4	86·9	77·3	74·4	85	·896	9	N. 68°11′ W.	29·0	15·0
October ...	81·5	75·9	88·4	77·4	72·0	77	·821	9	N. 77°50′ W.	30·0	13·0
November ...	77·5	69·1	84·0	72·5	66·1	63	·600	14	N. 19°32′ E.	35·0 (?)	18·0
December ...	72·6	62·8	80·3	67·3	59·4	55	·442	14	N. 10°55′ E.	23·0	12·0

* Mean of observations taken during month.

WALTAIR WIND OBSERVATIONS.

Mean Hourly Velocity.

Hours.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Mean.
0-1	...	...	...	11	15	15	13	11	5	6	9	10	10
1-2	...	...	...	11	15	14	14	12	6	6	9	9	10
2-3	...	...	...	10	15	14	14	12	6	6	10	10	10
3-4	...	...	...	10	15	14	14	13	6	6	10	10	10
4-5	...	...	...	10	14	14	13	13	6	6	9	10	10
5-6	...	...	...	10	14	14	14	13	6	6	10	10	10
6-7	...	...	...	10	15	15	13	13	7	6	10	10	10
7-8	...	...	...	12	17	14	13	14	7	7	10	10	11
8-9	...	...	...	12	19	17	14	17	8	7	11	13	13
9-10	...	...	...	14	21	21	15	19	10	10	13	15	15
10-11	...	...	...	19	24	18	18	21	11	13	18	18	18
11-12	...	...	...	22	26	23	19	21	12	14	20	21	20
12-13	...	...	...	23	26	23	20	22	13	14	21	22	21
13-14	...	...	...	22	25	26	21	21	14	15	21	22	21
14-15	...	...	...	21	23	24	20	21	15	15	21	22	20
15-16	...	...	...	19	23	22	19	21	14	15	21	21	20
16-17	...	...	...	19	22	20	18	19	13	13	18	19	18
17-18	...	...	...	17	20	16	16	16	11	10	16	16	16
18-19	...	...	...	14	18	15	13	14	8	8	15	15	13
19-20	...	...	...	13	17	13	13	12	8	8	15	13	13
20-21	...	...	...	14	17	13	12	11	7	8	14	14	12
21-22	...	...	...	13	15	12	12	11	7	7	12	12	11
22-23	...	...	...	13	15	13	13	11	6	6	10	10	11
23-24	...	...	...	12	15	14	14	11	6	5	10	9	11
Mean ...	...	...	...	15	19	17	15	15	9	9	14	14	14

WALTAIR WIND OBSERVATIONS.

Direction.

Months.	0–1 H.		1–2 H.		2–3 H.		3–4 H.		4–5 H.	
	Resultant.	Miles.	Resultant.	Miles.	Resultant.	Miles.	Resultant.	Miles.	Resultant.	Miles.
January ...	...	...	...	...	...	...	...	...	...	...
February ...	...	...	...	...	...	...	...	...	...	...
March ...	...	...	...	...	...	...	...	...	...	...
April ...	S. 57° 35′ W.	265·06	S. 56° 38′ W.	252·90	S. 58° 41′ W.	241·69	S. 60° 57′ W.	212·13	S. 56° 6′ W.	232·93
May ...	S. 50° 51′ W.	437·80	S. 57° 55′ W.	426·35	S. 54° 47′ W.	441·42	S. 50° 15′ W.	438·66	S. 52° 31′ W.	421·90
June ...	S. 44° 27′ W.	420·56	S. 42° 41′ W.	413·04	S. 49° 26′ W.	425·02	S. 51° 41′ W.	390·27	S. 46° 42′ W.	404·29
July ...	S. 55° 57′ W.	389·17	S. 56° 34′ W.	418·80	S. 49° 51′ W.	401·95	S. 53° 4′ W.	423·84	S. 56° 32′ W.	379·49
August ...	S. 54° 23′ W.	324·26	S. 55° 19′ W.	332·80	S. 54° 54′ W.	330·91	S. 53° 36′ W.	362·93	S. 54° 3′ W.	347·42
September ...	S. 74° 33′ W.	89·66	S. 85° 35′ W.	95·18	N. 89° 8′ W.	83·75	S. 87° 13′ W.	93·79	N. 76° 23′ W.	77·21
October ...	N. 51° 47′ W.	30·75	N. 63° 5′ W.	33·41	N. 32° 38′ W.	36·49	N. 83° 22′ W.	52·57	N. 74° 36′ W.	70·99
November ...	N. 36° 27′ E.	257·39	N. 34° 38′ E.	265·89	N. 30° 24′ E.	269·94	N. 23° 7′ E.	279·39	N. 23° 1′ E.	258·94
December ...	N. 21° 23′ E.	268·34	N. 18° 33′ E.	250·77	N. 19° 48′ E.	261·33	N. 13° 12′ E.	282·88	N. 15° 43′ E.	267·62

WALTAIR WIND OBSERVATIONS.—(*Continued.*)

Direction.

Months,	5–6 H.		6–7 H.		7–8 H.		8–9 H.		9–10 H.	
	Resultant.	Miles.	Resultant.	Miles.	Resultant.	Miles.	Resultant.	Miles.	Resultant.	Miles.
January ...	...	...	...	...	...	...	...	...	...	...
February ...	...	...	...	...	...	...	...	...	...	...
March ...	...	...	...	...	...	...	...	...	...	...
April ...	S. 57° 9′ W.	234·34	S. 62° 51′ W.	253·49	S. 50° 42′ W.	260·21	S. 50° 25′ W.	206·14	S. 26° 54′ W.	293·06
May ...	S. 53° 54′ W.	400·04	S. 51° 16′ W.	384·20	S. 47° 52′ W.	459·49	S. 42° 10′ W.	534·60	S. 24° 6′ W.	357·05
June ...	S. 50° 5′ W.	400·79	S. 50° 39′ W.	425·69	S. 40° 17′ W.	326·89	S. 50° 6′ W.	476·76	S. 32° 3′ W.	587·84
July ...	S. 57° 39′ W.	391·60	S. 56° 32′ W.	373·58	S. 58° 58′ W.	381·37	S. 51° 57′ W.	426·84	S. 37° 15′ W.	437·62
August ...	S. 52° 52′ W.	347·36	S. 56° 37′ W.	372·04	S. 51° 16′ W.	387·88	S. 45° 54′ W.	484·51	S. 43° 20′ W.	465·73
September ...	N. 86° 55′ W.	93·16	S. 76° 31′ W.	103·67	S. 76° 38′ W.	79·35	S. 72° 26′ W.	75·64	S. 66° 23′ W.	51·56
October ...	N. 79° 31′ W.	81·65	N. 62° 52′ W.	97·82	N. 72° 56′ W.	88·41	N. 56° 7′ W.	87·13	N. 28° 38′ W.	38·75
November ...	N. 21° 51′ E.	272·07	N. 17° 23′ E.	257·77	N. 17° 32′ E.	261·45	N. 18° 41′ E.	313·58	N. 26° 53′ E.	375·66
December ...	N. 16° 3′ E.	262·53	N. 11° 45′ E.	287·91	N. 14° 46′ E.	290·39	N. 16° 1′ E.	347·48	N. 20° 22′ E.	446·71

Months.	10–11 H.		11–12 H.		12–13 H.		13–14 H.		14–15 H.	
	Resultant.	Miles.	Resultant.	Miles.	Resultant.	Miles.	Resultant.	Miles.	Resultant.	Miles.
January ...	...	...	...	...	...	...	...	...	...	...
February ...	...	...	...	...	...	...	...	...	...	...
March ...	...	...	...	...	...	...	...	...	...	...
April ...	S. 14° 21′ W.	448·92	S. 6° 49′ W.	503·88	S. 8° 58′ W.	545·98	S. 9° 54′ W.	527·41	S. 13° 9′ W.	500·85
May ...	S. 16° 29′ W.	666·55	S. 11° 52′ W.	728·49	S. 10° 58′ W.	731·28	S. 7° 44′ W.	744·36	S. 13° 57′ W.	690·01
June ...	S. 25° 11′ W.	545·92	S. 18° 5′ W.	355·26	S. 17° 54′ W.	626·42	S. 20° 20′ W.	691·60	S. 19° 26′ W.	652·75
July ...	S. 29° 54′ W.	511·38	S. 20° 17′ W.	540·77	S. 19° 46′ W.	587·79	S. 16° 41′ W.	607·15	S. 24° 32′ W.	727·52
August ...	S. 37° 21′ W.	560·90	S. 29° 59′ W.	524·58	S. 24° 23′ W.	552·72	S. 27° 31′ W.	539·44	S. 24° 6′ W.	521·90
September ...	S. 21° 2′ E.	67·18	S. 21° 4′ E.	121·43	S. 24° 21′ E.	159·81	S. 17° 24′ E.	182·45	S. 16° 37′ E.	218·95
October ...	N. 56° 51′ E.	95·71	N. 65° 21′ E.	131·64	N. 75° 17′ E.	184·96	N. 86° 49′ E.	202·31	S. 69° 48′ E.	187·87
November ...	N. 36° 24′ E.	480·53	N. 51° 54′ E.	499·76	N. 49° 15′ E.	594·84	N. 51° 21′ E.	607·57	N. 53° 23′ E.	605·06
December ...	N. 32° 5′ E.	537·40	N. 44° 16′ E.	619·06	N. 46° 23′ E.	664·16	N. 48° 60′ E.	647·55	N. 54° 7′ E.	648·76

WALTAIR WIND OBSERVATIONS.—(*Concluded.*)

Direction.

	15–16 H.		16–17 H.		17–18 H.		18–19 H.		19–20 H.	
	Resultant.	Miles.	Resultant.	Miles.	Resultant.	Miles.	Resultant.	Miles.	Resultant.	Miles.
January ...	...	...	...	...	...	...	...	...	...	...
February ...	...	...	...	...	...	...	...	...	...	...
March ...	...	...	...	...	...	...	...	...	...	...
April ...	S. 10° 51′ W.	463·23	S. 15° 14′ W.	463·21	S. 16° 16′ W.	497·43	S. 29° 3′ W.	361·41	S. 36° 20′ W.	330·05
May ...	S. 17° 21′ W.	720·02	S. 19° 59′ W.	665·34	S. 24° 28′ W.	609·97	S. 30° 30′ W.	482·24	S. 37° 54′ W.	389·95
June ...	S. 23° 54′ W.	589·76	S. 20° 21′ W.	496·64	S. 29° 37′ W.	453·15	S. 27° 9′ W.	339·17	S. 39° 14′ W.	285·76
July ...	S. 23° 34′ W.	518·86	S. 25° 42′ W.	502·52	S. 35° 5′ W.	475·70	S. 41° 7′ W.	376·18	S. 42° 39′ W.	354·65
August ...	S. 22° 17′ W.	536·25	S. 24° 13′ W.	493·27	S. 29° 24′ W.	434·94	S. 37° 4′ W.	340·57	S. 35° 31′ W.	401·78
September ...	S. 26° 5′ E.	195·70	S. 3° 20′ W.	179·81	S. 0° 44′ W.	157·42	S. 5° 7′ W.	93·76	S. 17° 18′ W.	54·326
October ...	S. 84° 57′ E.	158·30	S. 84° 22′ E	120·56	N. 76° 19′ E.	90·73	N. 55° 28′ E.	63·33	N. 24° 20′ E.	36·30
November ...	N. 52° 42′ E.	589·83	N. 52° 48′ E.	525·30	N. 51° 23′ E.	477·68	N. 51° 31′ E.	423·27	N. 49° 24′ E.	426·36
December ...	N. 60° 37′ E.	559·80	N. 53° 8′ E.	531·73	N. 50° 51′ E.	450·61	N. 49° 57′ E.	437·06	N. 51° 17′ E	391·46

Months.	20–21 H.		21–22 H.		22–23 H.		23–24 H.		For whole month.	
	Resultant.	Miles.	Resultant.	Miles.	Resultant.	Miles.	Resultant.	Miles.	Resultant.	Miles.
January ...	...	...	...	...	...	...	...	...	...	...
February ...	...	...	...	...	...	...	...	...	...	...
March ...	...	...	...	...	...	...	...	...	...	...
April ...	S. 47° 38′ W.	365·55	S. 52° 31′ W.	284·29	S. 49° 36′ W.	326·21	S. 57° 15′ W.	281·43	S. 44° 8′ W.	4851·3
May ...	S. 37° 10′ W.	351·67	S. 49° 41′ W.	392·04	S. 52° 33′ W.	405·83	S. 43° 49′ W.	429·54	S. 32° 33′ W.	12017·0
June ...	S. 48° 17 ′W.	307·28	S. 42° 29′ W.	324·84	S. 39° 36′ W.	344·54	S. 44° 3′ W.	391·56	S. 40° 56′ W.	9420·3
July ...	S. 47° 13′ W.	364·05	S. 58° 6′ W.	342·21	S. 51° 52′ W.	390·95	S. 54° 0′ W.	418·49	S. 41° 22′ W	10061·6
August ...	S. 48° 51′ W.	285·89	S. 55° 46′ W.	282·44	S. 52° 12′ W.	304·52	S. 50° 54′ W.	299·14	S. 40° 36′ W.	9487·7
September ...	S. 51° 42′ W.	66·86	S. 58° 19′ W.	73·24	S. 68° 11′ W.	67·05	S. 68° 32′ W.	83·08	S. 27° 12′ W.	1794·7
October ...	N. 6° 34′ E.	66·75	N. 10° 29′ E.	47·55	N. 14° 17′ E.	44·76	N. 1° 54′ W.	34·14	N. 45° 48′ E.	902·2
November ...	N. 47° 50′ E.	376·35	N. 45° 11′ E.	348·20	N. 41° 48′ E.	287·79	N. 38° 56′ E.	264·27	N. 41° 23′ E.	9182 3
December ...	N. 48° 29′ E.	375·34	N. 46° 3′ E.	344·14	N. 37° 48′ E.	288·12	N. 36° 13′ E.	207·86	N. 38° 19′ E.	9375·0

WALTAIR WIND OBSERVATIONS.

(Direction.)

Months.	0–1 H.		1–2 H.		2–3 H.		3–4 H.		4–5 H.	
	Resultant.	Percentage.	Resultant.	Percentage.	Resultant.	Percentage.	Resultant.	Percentage.	Resultant.	Percentage.
January ...	...	...	...	...	...	...	...	...	...	...
February ...	...	...	...	...	...	...	...	...	...	...
March ...	...	...	...	...	...	...	...	...	...	...
April ...	S. 58° 42′ W.	96·3	S. 58° 50′ W.	94·1	S. 60° 31′ W.	91·6	S. 60° 13′ W.	87·7	S. 58° 48′ W.	87·5
May ...	S. 52° 25′ W.	95·8	S. 55° 25′ W.	95·6	S. 56° 41′ W.	95·2	S. 53° 4′ W.	95·7	S. 57° 0′ W.	96·9
June ...	S. 43° 31′ W.	91·1	S. 43° 27′ W.	94·5	S. 50° 15′ W.	95·6	S. 48° 48′ W.	96·4	S. 45° 52′ W.	96·2
July ...	S. 59° 39′ W.	94·3	S. 59° 28′ W.	89·1	S. 51° 22′ W.	91·8	S. 57° 14′ W.	92·9	S. 61° 34′ W.	90·7
August ...	S. 68° 3′ W.	45·2	S. 47° 10′ W.	61·6	S. 61° 41′ W.	73·1	S. 63° 41′ W.	76·1	S. 61° 40′ W.	74·9
September ...	S. 77° 30′ W.	41·3	N. 23° 8′ W.	45·2	N. 85° 17′ W.	40·9	N. 84° 43′ W.	43·7	N. 71° 30′ W.	44·5
October ...	N. 67° 16′ E.	4·5	S. 88° 36′ W.	1·0	S. 88° 53′ W.	1·4	N. 77° 35′ W.	14·2	N. 77° 35′ W.	27·8
November ...	N. 46° 7′ E.	91·0	N. 41° 24′ E.	90·7	N. 34° 52′ E.	88·9	N. 22° 7′ E.	87·4	N. 22° 7′ E.	87·4
December ...	N. 24° 36′ E.	95·5	N. 20° 25′ E.	85·9	N. 17° 51′ E.	88·4	N. 13° 18′ E.	86·4	N. 11° 2′ E.	85·0

Month.	5–6 H.		6–7 H.		7–8 H.		8–9 H.		9–10 H.	
	Resultant.	Percentage.	Resultant.	Percentage.	Resultant.	Percentage.	Resultant.	Percentage.	Resultant.	Percentage.
January ...	...	...	...	...	...	...	...	...	...	...
February ...	...	...	...	...	...	...	...	...	...	...
March ...	...	...	...	...	...	...	...	...	...	...
April ...	S. 58° 48′ W.	87·5	S. 63° 38′ W.	87·4	S. 59° 36′ W.	86·7	S. 56° 11′ W.	84·4	S. 29° 2′ W.	80·2
May ...	S. 57° 30′ W.	93·2	S. 57° 21′ W.	79·3	S. 50° 10′ W.	83·0	S. 40° 13′ W.	82·1	S. 28° 49′ W.	79·5
June ...	S. 51° 16′ W.	94·9	S. 51° 21′ W.	95·4	S. 49° 36′ W.	96·1	S. 50° 11′ W.	92·3	S. 33° 26′ W.	88·1
July ...	S. 63° 20′ W.	90·1	S. 63° 25′ W.	89·1	S. 64° 5′ W.	92·3	S. 53° 46′ W.	97·2	S. 37° 59′ W.	91·0
August ...	S. 56° 27′ W.	75·4	S. 62° 36′ W.	72·5	S. 53° 46′ W.	66·7	S. 40° 33′ W.	64·1	S. 41° 39′ W.	63·7
September ...	N. 65° 40′ W.	48·2	N. 15° 28′ W.	36·3	N. 78° 16′ W.	27·9	S. 64° 2′ W.	22·8	S. 82° 1′ W.	11·2
October ...	N. 71° 52′ W.	32·1	N. 63° 2′ W.	35·9	N. 70° 44′ W.	33·2	N. 73° 12′ W.	30·6	N. 30° 31′ E.	16·4
November ...	N. 18° 51′ E.	88·8	N. 13° 35′ E.	88·1	N. 12° 52′ E.	88·1	N. 16° 36′ E.	90·0	N. 24° 30′ E.	94·0
December ...	N. 11° 39′ E.	85·9	N. 6° 5′ E.	88·2	N. 7° 52′ E.	90·6	N. 12° 39′ E.	93·7	N. 19° 21′ E.	96·1

WALTAIR WIND OBSERVATIONS—(*Continued*).

(*Direction*)

Month.	10–11 H.		11–12 H.		12–13 H.		13–14 H.		14–15 H.	
	Resultant.	Percentage.	Resultant.	Percentage.	Resultant.	Percentage.	Resultant.	Percentage.	Resultant.	Percentage.
January ...	...	...	...	...	...	...	...	...	...	...
February ...	...	...	...	...	...	...	...	...	...	...
March ...	...	...	...	...	...	...	...	...	...	...
April ...	S. 9° 36′ W.	80·1	S. 4° 19′ W.	86·4	S. 8° 16′ W.	81·4	S. 8° 53′ W.	87·7	S. 13° 4′ W.	89·3
May ...	S. 14° 3′ W.	85·0	S. 9° 56′ W.	87·5	S. 9° 9′ W.	88·8	S. 5° 43′ W.	94·1	S. 13° 47′ W.	97·7
June ...	S. 26° 31′ W.	84·1	S. 17° 24′ W.	86·0	S. 29° 31′ W.	59·4	S. 19° 11′ W.	91·4	S. 21° 7′ W.	90·1
July ...	S. 30° 17′ W.	89·1	S. 43° 22′ W.	91·5	S. 21° 31′ W.	93·5	S. 18° 28′ W.	93·2	S. 23° 18′ W.	92·4
August ...	S. 34° 1′ W.	71·3	S. 28° 15′ W.	72·4	S. 19° 34′ W.	72·4	S. 23° 30′ W.	75·1	S. 19° 19′ W.	72·3
September ...	S. 8° 55′ E.	17·5	S. 14° 36′ E.	31·3	S. 21° 53′ E.	39·1	S. 34° 42′ E.	38·8	S. 16° 14′ E.	44·9
October ...	N. 78° 5′ E.	28·9	N. 75° 15′ E.	39·4	N. 82° 42′ E.	44·3	N. 80° 28′ E.	51·1	S. 83° 23′ E.	42·7
November ...	N. 36° 14′ E.	86·1	N. 44° 32′ E.	93·2	N. 50° 1′ E.	93·3	N. 52° 41′ E.	95·3	N. 56° 15′ E.	93·3
December ...	N. 31° 9′ E.	94·2	N. 46° 17′ E.	94·4	N. 47° 40′ E.	94·5	N. 51° 5′ E.	92·2	N. 56° 59′ E.	93·7

Month.	15–16 H.		16–17 H.		17–18 H.		18–19 H.		19–20 H.	
	Resultant.	Percentage.	Resultant.	Percentage.	Resultant.	Percentage.	Resultant.	Percentage.	Resultant.	Percentage.
January ...	...	...	...	...	...	...	...	...	...	...
February ...	...	...	...	...	...	...	...	...	...	...
March ...	...	...	...	...	...	...	...	...	...	...
April ...	S. 10° 39′ W.	89·7	S. 14° 48′ W.	90·7	S. 19° 30′ W.	90·5	S. 26° 1′ W.	93·4	S. 34° 45′ W.	94·3
May ...	S. 16° 43′ W.	98·0	S. 19° 38′ W.	98·7	S. 23° 51′ W.	96·6	S. 29° 21′ W.	90·1	S. 35° 19′ W.	76·7
June ...	S. 24° 49′ W.	85·1	S. 21° 42′ W.	81·3	S. 33° 40′ W.	89·8	S. 33° 47′ W.	66·7	S. 39° 10′ W.	75·9
July ...	S. 23° 42′ W.	85·7	S. 27° 46′ W.	87·9	S. 34° 38′ W.	86·1	S. 42° 29′ W.	92·6	S. 44° 39′ W.	89·0
August ...	S. 17° 18′ W.	81·5	S. 19° 44′ W.	78·0	S. 23° 22′ W.	77·0	S. 35° 55′ W.	70·6	S. 41° 26′ W.	71·2
September ...	S. 8° 40′ E.	40·8	S. 1° 15′ W.	44·6	S. 5° 44′ W.	46·3	S. 5° 3′ W.	41·3	S. 18° 11′ W.	26·8
October ...	S. 73° 5′ E.	44·8	S. 74° 45′ E.	46·7	S. 73° 40′ E.	35·6	N. 82° 7′ W.	28·7	N. 83° 15′ W.	23·0
November ...	N. 56° 1′ E.	94·2	N. 57° 29′ E.	94·2	N. 58° 12′ E.	94·7	N. 57° 55′ E.	91·9	N. 55° 51′ E.	91·8
December ...	N. 60° 31′ E.	89·0	N. 57° 17′ E.	88·7	N. 55° 1′ E.	88·3	N. 54° 28′ E.	89·0	N. 56° 47′ E.	89·6

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WALTAIR WIND OBSERVATIONS—(*Concluded.*)

(*Direction.*)

Month.	20–21 H.		21–22 H.		22–23 H.		23–24 H.		For whole month.	
	Resultant.	Percentage.	Resultant.	Percentage.	Resultant.	Percentage.	Resultant.	Percentage.	Resultant.	Percentage.
January ...	...	...	...	...	...	...	...	...	...	...
February ...	...	...	...	...	...	...	...	...	...	...
March ...	...	...	...	...	...	...	...	...	...	...
April ...	S. 46° 19′ W.	94·2	S. 54° 48′ W.	86·1	S. 51° 11′ W.	94·9	S. 58° 39′ W.	95·7	S. 38° 17′ W.	83 2
May ...	S. 39° 12′ W.	78·5	S. 50° 30′ W.	89·6	S. 52° 26′ W.	91·0	S. 51° 27′ W.	95·5	S. 36° 23′ W.	85 5
June ...	S. 43° 17′ W.	77·2	S. 43° 11′ W.	85·2	S. 46° 44′ W.	90·1	S. 43° 40′ W.	93·0	S. 39° 39′ W.	83·5
July ...	S. 51° 27′ W.	90·7	S. 58° 3′ W.	92·3	S. 54° 40′ W.	93·0	S. 58° 14′ W.	94·2	S. 45° 23′ W.	88·2
August ...	S. 47° 5′ W.	70·0	S. 55° 14′ W.	75·3	S. 52° 43′ W.	78·5	S. 53° 28′ W.	81·1	S. 48° 45′ W.	64·0
September ...	S. 40° 19′ W.	19·8	S. 38° 19′ W.	20·8	S. 62° 45′ W.	17·8	S. 60° 28′ W.	23·6	S. 44° 38′ W.	21·9
October ...	N. 81° 12′ E.	26·9	N. 7° 44′ E.	25·2	S. 80° 40′ E.	19·9	N. 67° 11′ E.	12·7	N. 82° 42′ E.	11·6
November ...	N. 55° 24′ E.	94·6	N. 53° 55′ E.	93·9	N. 53° 10′ E.	93·2	N. 69° 6′ E.	89·8	N. 41° 40′ E.	88·0
December ...	N. 55° 54′ E.	89·4	N. 52° 21′ E.	89·8	N. 40° 48′ E.	89·8	N. 33° 30′ E.	87·6	N. 37° 22′ E.	84·8

Comparison between Waltair and Vizagapatam.

Months.	Dry Bulb at 8 A. M.			Wet Bulb at 8 A. M.			Dry Maximum.			Dry Minimum.			Wet Minimum.			Humidity at 8 A. M.			Vapour Pressure at 8 A. M.		
	Waltair.	Vizagapatam.	Difference.	Waltair.	Vizagapatam.	Difference.	Waltair.	Vizagapatam.	Difference.	Waltair.	Vizagapatam.	Difference.	Waltair.	Vizagapatam.	Difference.	Waltair.	Vizagapatam.	Difference.	Waltair.	Vizagapatam.	Difference.
January ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...
February ...	78·4	79·1	−0·7	73 5	74·3	−0·8	86·2	88·9	−2·7	74·4	73·5	+0·9	70·8	71·6	−0·8	78	80	−2	·761	·789	−·028
March ...	80·1	81·6	−1·5	74·7	75·7	−1·0	83·9	90·0	−6·1	75·9	75·7	+0 2	72·3	73·3	−1·0	76	75	+1	·788	·821	−·033
April ...	83·8	85·9	−2 1	76·5	77·8	−1·3	89 7	93·7	−4·0	78·8	79·1	−0·3	73·8	75·5	−1·7	70	68	+2	·815	845	−·030
May ...	86·5	88·5	−2·0	79 9	80 9	−1·0	91·7	94·9	−3·2	81·2	82·2	−1·0	75·5	77·4	−1·9	74	71	+3	·933	·957	−·024
June ...	87·0	88·5	−1·5	79·4	80·3	−0·9	93·4	96·7	−3·3	82·5	83·4	−0 9	73·4	78·2	−4·8	70	69	+1	·903	·925	−·022
July ...	82·6	84·1	−1·5	77·6	78·3	−0·7	89·5	91·1	−2·4	79·2	80·2	−1·0	74·6	76·1	−1·5	79	76	+3	·881	·886	−·005
August ...	82·0	83·4	−1·4	77·6	78·1	−0·5	89·6	92·0	−2·4	78·4	79·4	−1·0	75·1	76·6	−1·5	81	78	+3	·888	·894	−·006
September ...	80·8	81·9	−1·1	77·4	78·2	−0·8	86·9	88·6	−1·7	77·3	77·7	−0·4	74·4	76·6	−2·2	85	84	+1	·896	·919	− 023
October ..	81·5	81·6	−0·1	75·9	76·4	−0·5	88·4	88·9	−0·5	77·4	75·7	+1·7	72·0	74·1	−2·1	77	78	−1	·821	·849	−·028
November ...	77·5	76·7	+0·8	69·1	70·0	−0·9	84·0	84·9	−0·9	72·5	69·8	+2·7	66·1	67·4	−1·3	63	71	−8	60)	·647	−·047
December ...	72·6	70·6	+2·0	62·8	63·1	−0·3	80·3	81·7	−1 4	67·3	62·7	+4·6	59·4	59·8	−0·4	55	65	−10	·442	·482	−·040

Difference of Old compared with New Exposure.

	4 H.		8 H.						10 H.		16 H.					22 H.	
	Dry.	Wet.	Dry.	Wet.	Max.	Dry Min.	Wet Min.	Grass Min.	Dry.	Wet.	Dry.	Wet.	Max.	Dry Min.	Wet Min.	Dry.	Wet.
January.																	
1st to 10th ..	+6·5	+3·6	+2·3	+1·2	−3·0	+6·9	+3·4	+1·0	−2·7	−0·7	−1·4	+0·2	−3 1	+6 9	+3·3	+3·9	+2·1
11th to 20th ...	+7·6	+4·4	+2·9	+2·0	−4·1	+8·1	+4·6	+2·9	−3·5	− 0·8	−1·9	+0·2	−4 1	+8·0	+4·5	+5·0	+2·7
21st to 31st ...	+6·6	+3·3	+2·3	+1·1	−3·5	+7·2	+3·7	+2·2	−3·1	−1·1	−1·8	+0·1	−4·0	+7·2	+3·7	+3·4	+2·0
Mean of month...	+6·9	+3·8	+2·5	+1·4	−3·5	+7·4	+3·9	+2·5	−3·1	−0 9	−1·7	+0·1	−3·7	+7·4	+3·8	+4·1	+2·2
February.																	
1st to 10th ...	+5·6	+2·9	+1·6	+0·5	−3·6	+6·6	+3·2	+1·9	−3·2	−0·8	−1·7	−0·2	−3·8	+6·6	+2·9	+3·3	+1·8
11th to 20th ...	+5·2	+2·8	+1·1	+0·3	−4·0	+5·8	+2·5	+2·1	−3·0	−1·2	−1·9	−0·1	−4·0	+5·8	+2·4	+2·4	+1 4
21st to 28th ...	+5·6	+2·9	+1·4	+0 9	−4·4	+6·4	+2·7	+2·1	−3·5	−0·7	−2·1	+0·1	−4·4	+6·4	+2·4	+2·7	+1·5
Mean of month...	+5·5	+2·9	+1·4	+0·6	−4·0	+6·3	+2·8	+2·0	−3·3	−0·9	−1·9	−0·1	−4·0	+6·3	+2·6	+2·8	+1·5
March.																	
1st to 10th ...	+5·4	+3·0	+1·1	+0·8	−4·2	+6·1	+2·7	+1·9	−3·2	−0·6	−1·6	−0·5	−4·4	+6·0	+2·5	+2·4	+1 3
11th to 20th ...	+4·0	+1·9	+0 3	−0·1	−4·1	+4·4	+1·8	+1·4	−2·8	−0·8	−1·2	−0·1	−4·1	+4·4	+1·5	+2·1	+1 3
21st to 31st ...	+4·4	+2·1	+0·3	+0·3	−4·1	+5·1	+1·5	+1·7	−2·7	−0·8	−1·5	+0·1	−4·0	+5·1	+1·3	+2·1	+1·3
Mean of month...	+4·6	+2·3	+0·6	+0·3	−4·1	+5·2	+ 2·0	+1·6	−2·9	−0·7	−1·4	−0·2	−4·2	+5·2	+1·8	+2·2	+1·3
April.																	
1st to 10th ...	+3·4	+1·9	−0·6	+0·3	−4·2	+4·4	+1·3	+1·4	−3·0	−0·6	−1·8	0	−4·3	+4·3	+1·0	+2·2	+1·1
11th to 20th ...	+3·2	+1·7	−1·0	+0·1	−4·6	+3·6	+1·3	+1·8	−3·3	−0·6	−1·5	+0·3	−4·5	+3·6	+0·9	+2·4	+1·4
21st to 30th ...	+2·9	+1·6	−1·4	+0·1	−4·4	+3·5	+0·8	+1·4	−3·4	−0·4	−1·5	+0·1	−4·4	+3·4	+0·4	+1·9	+1 1
Mean of month...	+3·2	+1·7	−1·0	−0·1	−4·4	+3·8	+1·1	+1·5	−3·2	−0·5	−1·6	+0·1	−4·4	+3·8	+0·8	+2·1	+1·2

May.																	
1st to 10th ...	+2·6	+1·2	−1·1	+0·1	−3·8	+3·3	+0·8	+1·0	−2·4	−0·5	−1·3	+0·1	−3·7	+3·2	+0·6	+1·7	+1·1
11th to 20th ...	+2·4	+1·3	−1·3	−0·1	−4·9	+3·2	+0·9	+1.1	−2·9	−0·4	−2·0	+0·3	−5·0	+3·2	+0·6	+1·8	+0·9
21st to 30th ...	+2·2	+0·8	−0·9	−0·2	−4·4	+2·8	+0·5	+0·8	−2·6	−0·6	−1·8	−0·2	−4·4	+2·8	+0·3	+1·6	+0·8
Mean of month ..	+2·4	+1·1	−1·1	−0·1	−4·4	+3·1	+0·7	+1·0	−2·6	−0·5	−1·7	0	−4·4	+3·1	+0·5	+1·7	+0·9
June.																	
1st to 10th ...	+2·0	+0·8	−0·6	+0·2	−4·1	+2·8	+0·6	+0·6	−2·5	−0·4	−0·9	+0·2	−3·9	+2·9	+0·3	+1·5	+0·9
11th to 20th ...	+2·4	+1·2	−0·2	+0·3	−3·8	+2·8	+0·4	+0·5	−2·1	−0·4	−1·2	−0·1	−3·8	+2·8	+0·4	+1·9	+1·2
21st to 30th ...	+2·3	+1·1	−0·8	+0·1	−4·6	+2·8	+0·5	+0·6	−2·6	−0·4	−1·9	−0·1	−4·4	+2·8	+0·2	+1·6	+0·7
Mean of month...	+2·2	+1·1	−0·5	+0·2	−4·2	+2·8	+0·5	+0·6	−2·4	−0·4	−1·3	+0·1	−4·1	+2·8	+0·3	+1·7	+0·9
July.																	
1st to 10th ...	+2·9	+1·6	0	+0·2	−4·7	+3·6	+1·3	+0·3	−2·2	−0·6	−1·6	−0·3	−4·1	+3·5	+1·2	+2·6	+1·2
11th to 20th ...	+3·3	+1·3	+1·0	+0·5	−2·9	+3·5	+1·3	+0·6	−1·1	−0·4	−0·8	−0·3	−2·9	+3·5	+1·4	+2·1	+1·0
21st to 31st ...	+2·2	+1·1	+0·5	+0·1	−3·0	+2·4	+0·9	+0·5	−1·4	−0·5	−1·2	−0·2	−3·2	+2·4	+0·8	+1·6	+1·0
Mean of month...	+2·8	+1·3	+0·5	+0·2	−3·6	+3·2	+1·2	+0·5	−1·6	−0·5	−1·2	−0·2	−3·4	+3·1	+1·1	+2·1	+1·0
August.																	
1st to 10th ...	+2·5	+1·0	+0·6	+0·2	−3·5	+2·9	+1·0	+0·5	−1·2	−0·4	−1·6	−0·5	−3·6	+2·9	+1·0	+1·3	+0·7
11th to 20th ...	+2·7	+1·4	+0·7	+0·1	−3·4	+2·9	+0·8	+0·4	−1·2	−0·4	−1·1	−0·1	−3·3	+2·7	+0·8	+1·8	+1·0
21st to 31st ...	+3·3	+1·6	+0·2	+0·3	−3·7	+3·8	+1·2	+0·4	−2·4	−0·6	−1·5	−0·1	−3·6	+3·7	+1·1	+2·0	+1·1
Mean of month...	+2·8	+1·3	+0·5	+0·2	−3·5	+3·2	+1·0	+0·4	−1·6	−0·4	−1·4	−0·3	−3·5	+3·1	+0·9	+1·7	+0·9
September.																	
1st to 10th ...	+3·6	+1·5	+1·3	+0·7	−2·7	+4·1	+1·3	+0·4	−1·1	−0·1	−0·1	+0·5	−2·8	+4·1	+1·4	+2·6	+1·1
11th to 20th ...	+3·2	+1·2	+0·4	+0·3	−3·9	+3·5	+1·2	+0·4	−1·6	−0·5	−1·9	−0·3	−3·8	+3·4	+1·1	+2·0	+0·8
21st to 30th ...	+3·8	+1·6	+0·2	+0·3	−3·3	+4·3	+1·5	+0·7	−1·9	−0·4	−1·1	+0·1	−3·4	+4·3	+1·4	+2·7	+1·4
Mean of month...	+3·5	+1·4	+0·5	+0·4	−3·3	+4·0	+1·3	+0·5	−1·5	−0·3	−1·0	−0·1	−3·3	+3·9	+1·3	+2·5	+1·1

	4 H		8 H.						10 H.		16 H.					22 H.	
	Dry.	Wet.	Dry.	Wet.	Max.	Dry Min.	Wet Min.	Grass Radn.	Dry.	Wet.	Dry.	Wet.	Max.	Dry Min.	Wet Min.	Dry.	Wet.
October.																	
1st to 10th ...	+4·2	+2·0	−0·5	0	−3·5	+4·9	+1·8	+1·0	−2·7	−1·1	−1·2	−0·2	−3·4	+4·8	+1·4	+2·8	+1·4
11th to 20th ...	+4·8	+2·4	−0·1	+0·4	−3·8	+6·2	+2·7	+1·4	−2·7	−0·6	−1·3	−0·1	−3 7	+6·2	+2·0	+2·9	+1·5
21st to 31st ...	+6·3	+3·2	+0·5	+0·5	−3·9	+7·2	+3·0	+2·4	−3·4	−0·8	−1·6	−0·1	−3·9	+7·3	+2·0	+4·0	+2·0
Mean of month...	+5·1	+2·5	−0·1	+0·3	−3·8	+6·1	+2·5	+1·6	−2·9	−0·8	−1·3	−0·1	−3·7	+6·1	+1·8	+3·2	+1·
November.																	
1st to 10th ...	+5·9	+2·9	+0·6	+0·4	−3·6	+7·0	+2·9	+2·3	−2·8	−0·6	−1·4	−0·4	−3·5	+6·9	+2·5	+3·3	+1·5
11th to 20th ...	+4·8	+2·4	+0·1	+0·6	−3·4	+5·4	+2·5	+1·8	−2·4	−0·4	−1·1	0	−3·7	+5·3	+2·0	+3·0	+1·5
21st to 30th ...	+3·8	+1·8	+0·7	+0·4	−2·3	+4·4	+1·7	+1·3	−2·1	−0·8	−0·5	−0·1	−2·5	+4·4	+1·5	+2·6	+1·3
Mean of month...	+4·8	+2·4	+0·5	+0 5	−3·1	+5·6	+2·4	+1·8	−2·4	−0·6	−1·0	−0·2	−3·2	+5·5	+2·0	+3·0	+1·4
December.																	
1st to 10th ...	+6·3	+3·4	+2·0	+0·8	−3·1	+7·2	+3·3	+2·6	−3·1	−1·2	−1·4	−0·2	−3·3	+7·2	+3·1	+4·1	+2·2
11th to 20th ...	+6·3	+3·6	+1·5	+1·2	−3·0	+7·7	+3·4	+2·3	−2·9	−1·0	−1·6	−0·3	−3·1	+7·7	+2·5	+3·4	+1·8
21st to 31st ...	+4·8	+2·6	+1·0	+0·8	−3·2	+5·6	+2·4	+0·3	−3·0	−1·2	−1·5	−0·4	−3·3	+5·6	+2·2	+2·5	+1·4
Mean of month...	+5·8	+3·2	+1·5	+0·8	−3·1	+6·8	+3·0	+1·7	−3·0	−1·1	−1·5	−0·3	−3·2	+6·8	+2·6	+3·3	+1·8

LIBRARY OF THE BOMBAY BRANCH OF THE ROYAL ASIATIC SOCIETY

APPENDIX III.

Additions to the Library.

Presentations.

Asiatic Society of Bengal.

(1) Proceedings, January to July, 1897.
(2) Journal, Vols. LXVI, Part II, Nos. 1 and 2.

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(1) Rainfall in the East India Archipelago for 1896. 8vo. Batavia, 1897.
(2) Observations made at the Magnetical and Meteorological Observatory, Vols. XVIII and XIX, 1895 and 1896. 4to. Batavia.

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(1) Indian Meteorological Memoirs, Vols. IV, Parts 8; V, 1-3; VII, 6-7; VIII, 2; IX, 8-9. 4to. Calcutta, 1892-97.
(2) Monthly Weather Review, February to December, 1892; January and March to June, 1893; February and March, 1894; April, 1895; June to December, 1896; January to July, 1897. 4to. Calcutta, 1892-97.
(3) India Weather Review, Annual Summary, 1892, 1895 and 1896. 4to. Calcutta, 1893-97.
(4) Report on the Meteorology of India in 1882 and 1890. 4to. Calcutta, 1884 and 1892.
(5) Forecast of the probable character of the south west monsoon rains of 1897. Fcp. Simla, 1897.
(6) Forecast of rainfall in August and September, 1897. Fcp. Simla, 1897.
(7) Report on the administration of the Meteorological Department, Government of India, 1896-97. 8vo. Calcutta, 1897.

(8) India Daily Weather Report, 25th December, 1896 to 24th December, 1897. 4to. Simla.

(9) International Cloud Atlas. 4to. Paris, 1896.

(10) Summary and review of international meteorological observations for July to December, 1884; January to March and June, 1885; and January to April, June and August, 1886. 4to. Washington, 1885–87.

(11) Report of the chief of the Weather Bureau, U. S. A., 1891–94. 8vo. Washington, 1893–95.

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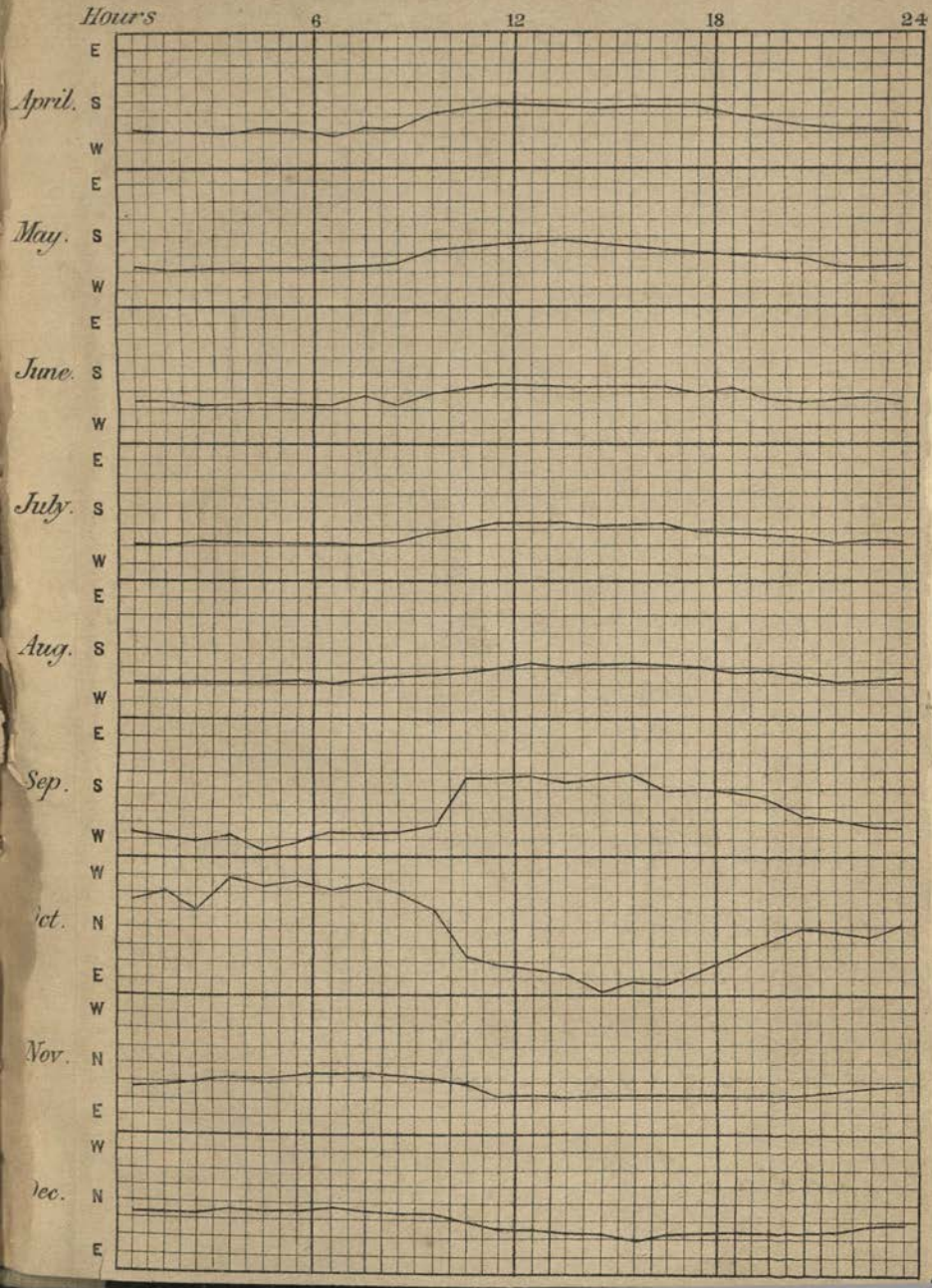

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